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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE
INSTITUTE OF BRITISH FOUNDRYMEN AND THE
WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen

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Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

The American Visit.

Last Friday some thirty prominent foundrymen landed in Europe to take part in the Paris Conference, which can truthfully be described as the first real international foundry congress. Whilst at Birmingham there were delegates from most of the foremost nations, in this case the congress has been thrown open to any foundryman attached to the various great national technical organisations.

We attach the utmost importance to this event, as matters of international importance will be put well on the road to settlement, if not finally disposed of.

The most prominent of these is the fixing of a standard international test bar for cast-iron for grey iron castings. A special sitting will be given in Paris for the discussion of this problem. Another subject likely to be discussed is the question of the grading of pig-iron by analysis. One very prominent American states that he is a large buyer of "warrant" iron, which he grades himself and disposes of the irons not falling within the limits he considers should be associated with the number ordered. This usually amounts to fifteen per cent.

A prominent Canadian visitor, on the other hand, states that he recently bought a large shipment of British iron, which, he states, was much more regular in composition than any bought from the States on an analysis basis. This sounds very contradictory, but open discussion on these lines should be productive of much data which should be helpful in regularising international trade. There are many other similar products which require similarly dealing with, such as cast-iron pipes, the American being, in general, longer than British ones. The result of this is that countries being developed specify a type abnormal for either the one country or the other. Obviously quotations are not always comparable.

A further object is to decide the question of future international meetings, because that, now we have put our hands to the plough, there is no withdrawing, and foundrymen of the world will in future consider these as essentials in their technical education. To quote a prominent visitor, we must get one another's viewpoint, in order to assure that international business, the lifeblood of this country, is to be conducted on the best lines.

Finally, as official organ of the Institute of British Foundrymen, we extend to the visitors a very hearty welcome, and assure them that we will make every effort to ensure that their visit will be instructive and pleasurable.

A TELEGRAM OF WELCOME.

Clamer, President, American Foundrymen's Association, Hotel Cecil, London.

On behalf of the Institute of British Foundrymen, I wish the Members of your Association and your good self a most enjoyable visit to our country, and may our Meetings result in further cementing the good feelings existing between us.—Oliver Stubbs, President.

The Visit of the American Foundrymen's Association.

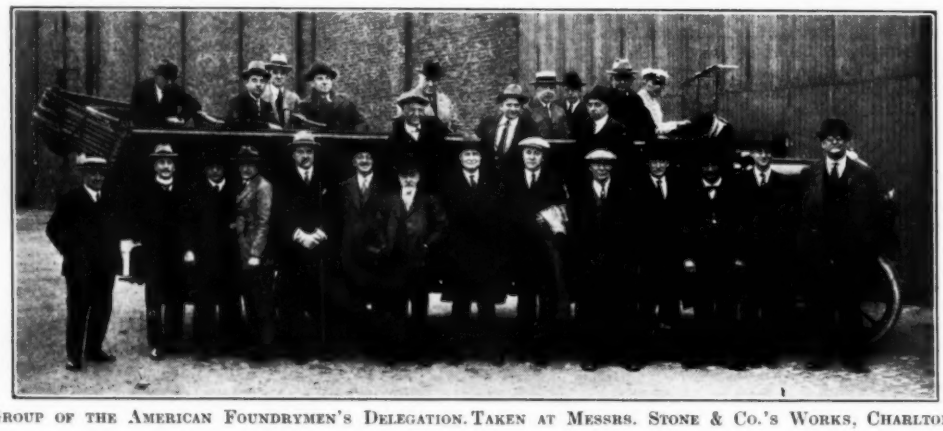
The party of the members and wives of the American Foundrymen's Association, numbering about 35, arrived at Southampton at mid-day on Friday. The list of their names is printed below. On Saturday morning they were received in the Medici Room at the Hotel Cecil by the members of the London Reception Committee. The ladies were presented with bouquets of English roses by Mrs. Cheesewright.

Excursion to Windsor.

In the afternoon the party, accompanied by a number of members of the London Branch of the Institute of British Foundrymen, journeyed to Windsor Castle by motor coach. Special arrangements were made for them to inspect the State Apartments. Tea was served at the White Hart Hotel, where Mr. Vincent C. Faulkner, the president-elect of the London Branch, welcomed the visitors on behalf of the Institute. The return journey was made via Staines and Hampton Court, town being reached at 7.30. On Sunday no arrangements were made for their entertainment.

Visit to Messrs. J. Stone and Company's Works.

At 9.30 on Monday morning the party left by motor coach to visit the propeller foundry of Messrs. J. Stone & Company, Limited, at Charlton, where, under the guidance of Messrs. Wesley Lambert, Clavering, Hart, Allum, McConnell and Mainsbridge they were shown the complete manufacture of the largest types of marine propellers. The visitors were particularly impressed with the fact that the metal during melting is controlled microscopically.



Group of the American Foundrymen's Delegation. Taken at Messrs. Stone & Co.'s Works, Charlton.

Lunch at the Ship Inn, Greenwich.

Luncheon was taken at the Ship Hotel, Greenwich. It was quite an informal affair at which Mr. V. C. Faulkner presided.

Mr. V. E. Minich, a director of the American Foundrymen's Association and president of the American Foundry Equipment Company, took the opportunity of proposing a hearty vote of thanks to the directors of Messrs. J. Stone and Company for their kindness in throwing open their doors to the American Foundrymen's Association. With this vote of thanks he coupled the names of Mr. Wesley Lambert and his associates, who had so kindly given up their time to explain to them so carefully the manufacture of propellers. He complimented the firm on the tidyness, cleanness, and lightness of their foundries. They compared more than favourably with similar plants in the States. He was delighted with the magnificent reception accorded them by the London Branch of the Institute of British Foundrymen and the Iron and Steel Institute since their arrival.

The vote was formally seconded by Mr. Jesse L. Jones, chief metallurgist to the Westinghouse Electric and Manufacturing Company.

Mr. Lambert briefly acknowledged, and on a request from the Chairman gave a synopsis of the history of the district, including the Royal Naval College, the Parish Church, the Painted Hall, and the Observatory.

Afternoon Visits.

The afternoon was spent visiting the Painted Hall and Chapel buildings at the Royal Naval College, followed by a visit to the Royal Observatory.

Whilst the foundries were being visited, the ladies of the party were taken sight-seeing and shopping by Mrs. V. C. Faulkner, Miss Hollinworth, and Mrs. H. J. Maybrey.

List of Visitors.

At the informal reception at the Hotel Cecil on Saturday morning the visitors were cordially welcomed by the Reception Committee, Col. W. F. Cheesewright, D.S.O., Mrs. W. F. Cheesewright, Mr. and Mrs. Wesley Lambert, Mr. and Mrs. V. C. Faulkner, and Mr. and Miss Hollinworth, and the names of the following American visitors were registered as taking part in the various functions :—

Mr. C. E. Bell, C.S. Bell Company, Hillsboro', Ohio; Mr. E. W. Campion, Buckeye Steel Castings Company, Columbus, Ohio; Mr. and Mrs. G. H. Clamer and daughter, c/o Ajax Metal Company, Philadelphia, Pa., president A.F.A.; Mr. W. E. Dunn, junr., Southern Metal Trades Corporation, Atlanta, Ga.; Mr. C. Earnhill, Fay & Scott, Dexter, Maine; Mr. C. H. Gale, 1418, West 84th Street, Cleveland, Ohio; Mr. and Mrs. C. S. Gilbert, Canada Iron Foundries, St. Thomas, Ont.; Mr. and Mrs. John Hill, Hill & Griffith Company, Cincinnati, Ohio; Mr. Jesse L. Jones, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., past president, Institute of Metals; Mr. and Mrs. G. W. Knotts, Youngstown, Ohio, United Engineering and Foundry Company; Mr. George H. Kramer, Dayton Trust and Savings Company, Dayton, Ohio; Mr. and Mrs. Peter J. Krentz, Buffalo Foundry and Machine Company, Buffalo, N.Y.; Mr. L. S. Lehman, S.B. Sexton Stove and Manufacturing Company, Baltimore, Md.; Mr. James Linklater, Michigan Malleable Iron Company, Detroit; Mr. and Mrs. J. S. McCormick, J. S. McCormick Company, Pittsburgh, Pa.; Mr. and Mrs. Verne E. Minich, American Foundry Equipment Company, 366, Madison Avenue, New York City; director A.F.A.; Dr. and Mrs. Richard Moldenke, Watchung, N.Y.; Mr. W. H. Nicholls, W. H. Nicholls Company, Incorporated, Brooklyn, New York; Mr. Q. S. Snyder, Phœnix Roll Works, Pittsburgh, Pa.; Mr. and Mrs. R. E. Turnbull, Arcade Manufacturing Company, Chicago; Mr. George Wadsworth, Wadsworth Core Machine Company, Akron, Ohio; Mr. and Mrs. Ralph West, West Steel Casting Company, Cleveland, Ohio; Mr. W. S. White, J. S. White Company, Pawtucket, R.I.; and Mr. Walter Wood, R. D. Wood & Company, 400, Chestnut Street, Philadelphia, head of committee of American Foundrymen's Association dealing with international specifications for cast iron.

THE BANQUET.

Sir Robert Hadfield on Foundry Conditions.

This function was held in the evening at the Hotel Cecil, and was offered jointly by the London Branch of the Institute of British Foundrymen and the Iron and Steel Institute.

MR. WESLEY LAMBERT, the retiring President of the London Branch of the Institute of British Foundrymen, presided, and in the name of the Iron and Steel Institute and the London Branch of the Institute of British Foundrymen, before dinner was commenced, welcomed the American delegates.

In giving the toast of "The King and the President of the United States,"

The CHAIRMAN said that as this was probably the first semi-public function that the majority of the guests had attended in this country since the death of President Harding, it seemed to him only fitting that he should bear testimony by word of mouth to the very deep feeling of sympathy prevailing in this country with our friends across the sea in their recent sudden and very great loss, and in giving this toast he did so with every wish for the health and success of the new President of the United States.

SIR ROBERT HADFIELD, F.R.S. (Past President of the Iron and Steel Institute, and honorary member of the Institute of British Foundrymen) proposed "The American Foundrymen's Association." After expressing the hope that the delegates from America would have a good time in this country, he said it was with the very greatest pleasure that he was present to meet

MR. H. G. CLAMER.

Mr. Clamer is the President of the American Foundrymen's Association and a Director of the Franklin Institute, one of the oldest and most important technical societies in the U.S.A. He is Vice-President and General Manager of the Ajax Metal Company, of Philadelphia, Pa.

the delegation of American visitors, and in whose honour, on behalf of the Institute of British Foundrymen and the Iron and Steel Institute he proposed this toast. Many years ago the British Foundrymen's Association was good enough to make him an honorary member of the Association, which he had always most highly appreciated. He had always admired the work of the Association, and was only too pleased to do anything he could to assist in the excellent objects it had in view. On behalf of the President of the Iron and Steel Institute (Mr. Francis Samuelson), who much regretted being unable to be present that evening, he offered the American delegates a most hearty welcome to London. The Institute had also been very glad to assist in carrying out the evening's entertainment. Four of the delegates from America were old personal friends of his, viz., Mr. Clamer, Dr. Moldenke, Mr. Stanley Flagg, and Mr. Walter Wood. He often used to meet them in his earlier journeys to the United States, and had always received the greatest possible kindness from them. As regards Mr. G. H. Clamer, the new President of the American Foundrymen's Association, his splendid work in helping on the science of metallurgy, particularly that section relating to non-ferrous products, was highly appreciated not only in his own country, but here also. Then his connection with the Franklin Institute over a long period entitled him to our highest respect for the work he had done there. Mr. Clamer was Chairman of the Committee of the Franklin Institute, which in 1911 was kind enough to do him the great honour of presenting him with the Elliott-Cresson gold medal for his ferrous researches. He would never forget Mr. Clamer's great kindness and the favourable way in which he was kind enough to describe his researches. Dr. Moldenke's name was a household word not only in America but throughout the world on foundry questions We all owed him a great debt of gratitude, as he was one of the first to see the great importance and necessity of applying science to foundry practice. The old foundry was a gloomy, dark hole in more senses than one; now we have modern, well-built establishments, well lighted and wonderfully free from smoke, fumes and dust. In the same way, the light of science had been turned on to dark corners of our minds, and our knowledge greatly increased. With regard to Mr. Stanley Flagg, a Past-President of the American Association, and also Vice-Chairman of the Committee on International Relations of the A.F.A., he had also very pleasant memories of various interviews with him on matters regarding foundry subjects. Mr. Walter Wood was the head of the Committee of the American Foundrymen's Association, dealing with international specifications for cast iron. He specially remembered Mr. Wood's courtesy when the Iron and Steel Institute visited Philadelphia. There was also present Mr. G. C. Lloyd, the able Secretary of that cosmopolitan body, the Iron and Steel Institute. He said advisedly cosmopolitan, though, unfortunately, like many other bodies, during the war they had to expel certain sections of the members, but whose fault was it? It was most certainly not the fault of the Institute. As soon as these countries returned to a decent, sane and civilised life we were prepared to give them the same facilities as existed before the war, but certainly not until they expressed their regret for the world upset they had brought about. Their penitence, too, must be expressed by their deeds, and not by words alone.

Medallions Exhibited.

After consulting with the Secretary of the British Foundrymen's Association, and obtaining his approval, he would take the liberty of making this occasion the opportunity of showing them something of the foundrymen's art in steel, in the exhibition of the medallions of three famous individuals. Two of them had in the past nobly done their part in the world's work. The third represented one, happily alive and with us to-day, who is also doing his share in helping along the world's progress. He referred in the first two cases to two Americans, George Washington and Benjamin Franklin, and the other was that popular countryman of ours, H.R.H. the Prince of Wales. We could almost say of him "first in arts, first in peace," and we could most positively say of him, as of the great founder of the American Republic, "first in the hearts of his countrymen."

As regards George Washington, we all knew the wonderful work he helped to start; the "founding" —to use a technical expression—of the great American public. And what a casting that had been!—3,000 miles square. It would take all the iron ore in the world to cast it. This great body politic was to-day a modern wonder of civilisation, standing under one flag and for one purpose, the advancement of freedom, liberty and progress. It was not necessary for him to go into the details of Washington's great career. Both countries were to be congratulated that since his time the two nations had become more and more united in friendship and respect. This we in this country had tried to show quite recently in that great memorial service in Westminster Abbey, the Valhalla of the Anglo-Saxon race, on behalf of the late President of the United States, whose death we all deplored. It seemed to him that if these two nations shared their feelings in times of sorrow, it was very evident that in times of opposite nature we must go hand in hand. Heaven grant that it may be so, for in many ways one country was the complement of the other.

As regards Benjamin Franklin, we also claimed him as having been very near in spirit and at heart with us in many ways. It might be interesting to recall that in 1753 Franklin was awarded the Copley medal of the Royal Society, the highest honour which that Society could grant. At the time that the presentation was made the then President of the Royal Society said: "This mark of distinction is doubly due to Mr. Franklin: it is due to him as a philosopher, it is due to him as a man. His public spirit, his modesty, goodness and benevolence have long been conspicuous, and the effect of them long felt in the country where he resides." One of the well-known American Institutes bore the great name of Benjamin Franklin, the Franklin Institute, Philadelphia, Pa., founded in his honour so long ago as 1854. It had done splendid work on behalf of scientific develop-

ment, and they were specially glad to welcome the new President of the American Foundrymen's Association, who had done such excellent work in connection with the Franklin Institute. He was sure that it would be of special interest to their American friends to know that William Pitt, afterwards the Earl of Chatham, and Benjamin Franklin signed the Charter Book of Fellowship on exactly the same page, in fact, within a few inches of each other. If any of them would like to see that Charter Book he would arrange with the Royal Society for them to do so. Before admission to the Royal Society every Fellow must sign this book, which dated back to 1662 and contained the signature of every Fellow elected, and speaking as a humble member of the Royal Society, and giving this as an example, his own signature followed on, not many pages away from those of King Charles II., King James II., Lord Brouncker (the first President of the Royal Society), and all the great men who had passed down the roll call of time since 1660, including such names as Newton, Wren, Franklin, Priestley, Watt, Pitt, the Duke of Wellington, Humphry Davy, Faraday, Robert Stephenson, Joule, Darwin, Tyndall, Huxley, Kelvin, and scores of other great names.

As regards the Prince of Wales, and the medallion to which he had already referred, this recently came into existence in the following manner: The Prince was visiting the works of his firm at Sheffield on May 29, and in order to interest him in foundry work it was thought to be a good idea to have a model of himself prepared, and this was done by the well-known sculptor, Mr. S. Nicholson Ball, of London. A mould was prepared from the pattern, so that when the Prince came down this was all ready for "closing." But before doing this, and in order that the casting might possess some mark of the Prince's personality, he had had prepared a small facsimile of his signature, with which his Royal Highness was good enough to stamp the mould. It was then closed and poured from manganese steel, and the result was present that evening. The particular medallion exhibited was of special interest because it was presented to and accepted by the Prince of Wales, and thus become his property.

Finally, Sir Robert made reference to the Institute of British Foundrymen. The membership was, he said, now 1,500, and, having regard to the fact that the population of this country was half that of America, the number could be said to be 3,000, which was a very good record for a Society which had not been established very long, and Mr. Stubbs, the President, Mr. Wesley Lambert, the President of the London Branch, and the Secretary, Mr. Hollinworth, were to be congratulated. Before sitting down he would like to say a word on foundry advance in America. When he paid his first visit to America, something like thirty years ago, the number of steel foundries could almost be counted on the fingers of one hand, but now look at the enormous development that had taken place! The output of steel, iron and brass castings was something like three and a half million tons a year. In this country we were only too glad to see such prosperity in America. He only wished the American delegates were being welcomed at a time when there was more prosperity in this country, but they would all do their level best to make the visit a complete success. The Institute of British Foundrymen felt it was indebted to the American Foundrymen's Association and that it ought to pay; he only wished some of the countries on the Continent would take that same point of view. (Laughter.) He believed that when we did have an era of peace and prosperity it would be one such as the world had never known. He hoped that prosperity would not only touch those at the head, but would also apply to the workmen, who deserved their share in any such national prosperity.

Sir George Goodwin on Foundry Practice.

Engineer Vice-Admiral Sir George Goodwin, K.C.B. (President of the Institute of Marine Engineers), said he felt it an honour to be asked to second this toast. Whilst he could not speak with the same authority on this subject as Sir Robert Hadfield, who was a practical foundryman, he had come into contact with foundrymen during his career as a marine engineer serving in the Royal Navy. In the course of those duties he had served in many dockyards and shore establishments, and the fact that he had been brought into contact with foundrymen at various times had been a great help to him. This association began many years ago when he was appointed assistant to the chief engineer at Chatham Dockyard. That was a long time ago, but he came there into contact with the work of the founders and it was most interesting. He made it his business to get into touch with all the details of the foundry work, foundry methods and foundry economies, such as they were in those days, as well as foundry costs and, last but not least, foundry tricks. There were tricks in every trade and there were certainly some in the foundry. He formed the conclusion then, looking back on the state of affairs as it then existed, that the most backward branch of the engineering industry was foundry work. He noticed that that was not applauded (laughter), but he could assure them that that was his present conviction, and he thought there was a reason for it. Every other branch of engineering had received assistance from science and by co-operation with other branches. Even those who felt that the foundry trade was backward did not adopt the best methods. Work was turned out very slowly, and on one occasion when he was very young it was made his job to see if he could not get melts from the furnaces more quickly. At that time experiments were being carried out with forced draught in order to get more power out of the boilers, and remembering some of the tricks of the foundry trade, he thought he would play a trick upon it. He therefore tried the effect of forced draught on some reverberatory furnaces (laughter) in order to get the melts more quickly. He certainly got the melts more quickly but he now shuddered to think what he might have done. There was said to be a cherub up aloft who looked after lots of people such as children, drunken men and sailors, and he must have had charge of those concerned in this little affair on that occasion (laughter). He did not, however, think that the founders had the help from science in those days which they ought to have had. The state of affairs was very different to-day in this country. The delegates had just paid a visit to Charlton, and the foundries there were typical of the best in this country. Not only was the best of experience brought to bear upon foundry work there, but these foundries demonstrated in a very marked manner the value of science in metallurgy and foundry operations. In that way results were obtained which we were very proud of in this country. It was realising that foundry work was backward in this country that the Institute of British Foundrymen took the problem in hand. The motto of the Institution was "Science hand in hand with Labour," and the Institute was working to that motto conscientiously, accurately, and extremely well. It was due to these efforts that the improvement in foundry work in this country was largely due. In this same connection he had noticed, whilst he was President of the Institute of Metals a year or two ago, what a vast amount of information came from America bearing on foundry work and metals generally, and inquiry had shown him that this was due to the efforts of similar societies in the United States. In adding his own welcome to that already offered the delegates from America he said that we did not look upon visitors from America as foreigners, but as Englishmen and Scotsmen who had gone across to the other side (laughter), and he hoped that sentiment would last for a very long time.

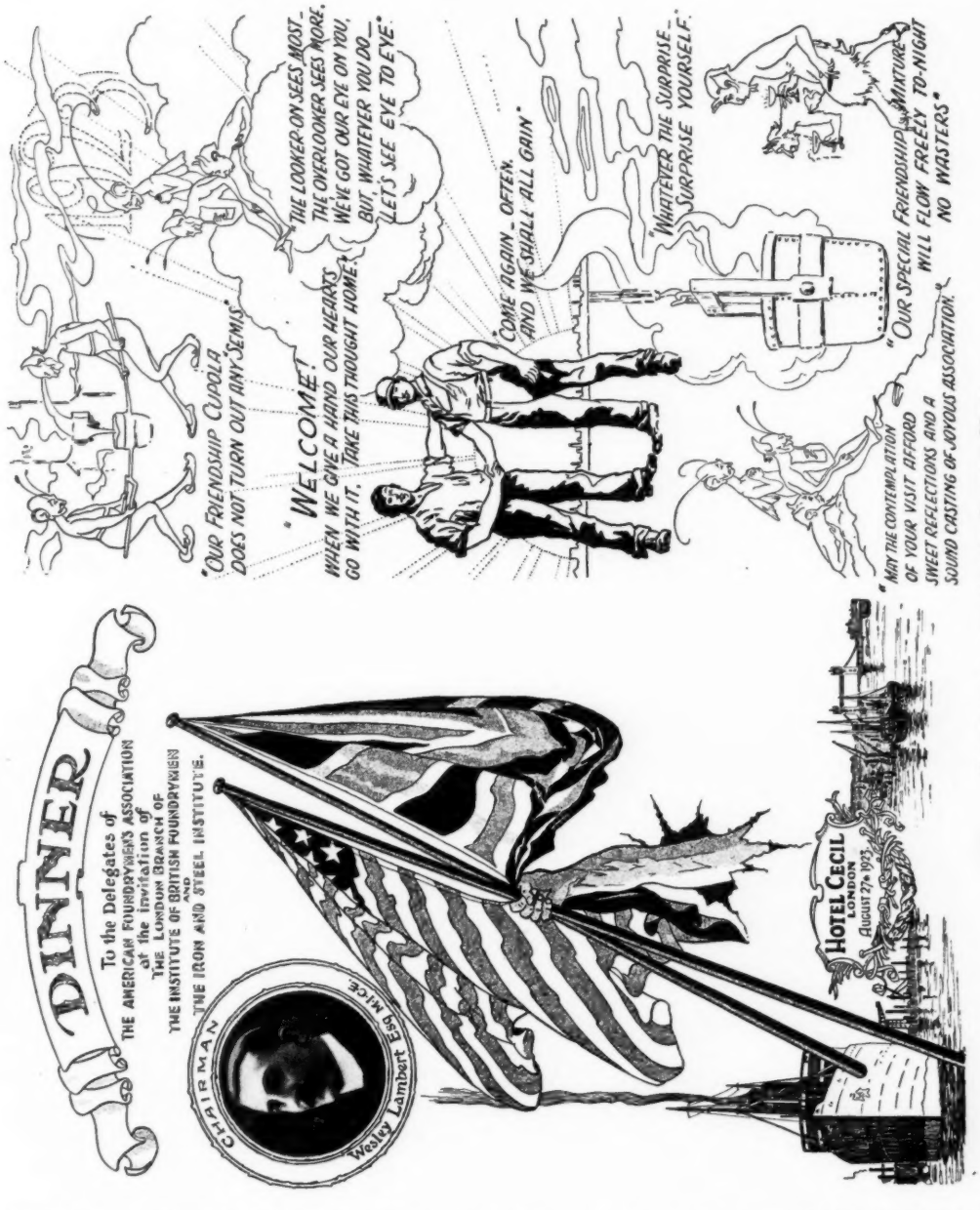
The American President's Reply.

Mr. G. H. Clamer (President of the American Foundrymen's Association), who was most enthusiastically received on rising to respond to the toast, said he felt quite unable to respond to the beautiful sentiments which had been expressed by the proposer and seconder of the toast. At the Rochester Convention of the American Foundrymen's Association in June, 1922, they received an invitation from the French Technical Foundry Association to attend the International Foundry Conference to be held in Paris this year, but prior to that meeting in Rochester the American foundrymen had the honour, and very great pleasure, of entertaining the President of the Institute of British Foundrymen, Mr. Oliver Stubbs, and the past President, Mr. Tom Firth. That was in May or April before the Rochester Convention, although these gentlemen did not find it possible to extend their visit so as to be able to attend the Rochester Convention. The Convention, however, was attended by a past President in Mr. F. J. Cook. Sir Robert Hadfield was well known to founders in America. He had visited America many times and, as mentioned by Sir Robert, he (the speaker) had the privilege of being chairman of a committee appointed by the Franklin Institute to investigate the life work of Sir Robert Hadfield. The committee made a very exhaustive investigation of Sir Robert's work, and were utterly astounded at the magnitude and the excellence of the work he had done in the iron and steel field. (Loud applause.) The committee had no trouble whatever in reaching the conclusion quickly that Sir Robert was entitled to recognition by the Franklin Institute, and the committee recommended to the Board of Directors of the Institute that the Elliott-Cresson gold medal should be awarded to Sir Robert Hadfield, which was the highest award within the gift of the Institute. That award was made about 10 years ago. Not only had

foundrymen on both sides of the Atlantic become acquainted, but they had felt that on both sides there was an earnest and anxious desire to co-operate. It was with these feelings that, immediately upon hearing the Americans had been invited to the Paris Conference, the British foundrymen invited them also to visit England. That invitation was highly appreciated.

The delegates knew from the programme that their hosts had planned bountifully for them; they felt too bountifully, and it was deeply appreciated. Speaking generally on foundry matters, Mr. Clamer said the time when business men cherished secrets and carefully secluded and jealously guarded their processes of production, had passed. Co-operation had avoided wasteful competition and efficiency had been increased

nations and the desire to do away with national egotism was rapidly growing. The invitation to inspect British foundries was one of the ways in which the foundrymen of Great Britain were earnestly endeavouring to establish a means for the exchange of ideas relating to metal industries. It was the earnest hope of American foundrymen that the next international conference would be held in America, and that American foundrymen would then have the opportunity and great pleasure of entertaining a large delegation of members from both the Institute of British Foundrymen and the Iron and Steel Institute, and other technical organisations connected with the foundry industry. This was his first visit to England, and he had been here such a short time that he had not yet had the opportunity of seeing the dif-


"OUR FRIENDSHIP CUPOLA DOES NOT TURN OUT ANY SEMIS."
"WELCOME! WHEN WE GIVE A HAND OUR HEARTS GO WITH IT."
"THE LOOKER-ON SEES MOST." "THE OVERLOOKER SEES MORE." "WE'VE GOT OUR EYE ON YOU, BUT WHATEVER YOU DO— LET'S SEE EYE TO EYE."
"COME AGAIN—OFTEN. AND WE SHALL ALL GAIN."
"WHATEVER THE SURPRISE— SURPRISE YOURSELF."
"OUR SPECIAL FRIENDSHIP MIXTURE WILL FLOW FREELY TO-NIGHT NO WASTERS."
"MAY THE CONTEMPLATION OF YOUR VISIT AFFORD SWEET REFLECTIONS AND A SOUND CASTING OF JOYOUS ASSOCIATION."
DINNER
To the Delegates of THE AMERICAN FOUNDRYMEN'S ASSOCIATION at the Invitation of THE LONDON BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE IRON AND STEEL INSTITUTE.
CHAIRMAN
Wesley Lambert Esq
HOTEL CECIL LONDON August 27th 1923

THE COVERS OF THE LONDON BANQUET MENU.

by the more confidential relations between employers and employees. A nation was nothing else than a business organisation. Its prime obligation was so to organise and regulate its productive capacity as to ensure to each individual a proper return for his effort. As individual businesses had learned from experience the benefits of unselfish co-operation, so the nations of the world were beginning to realise that industrial progress depends upon international co-operation. Commercial rivalry in the world market must be as open as competition in the home market. The same principles must be adopted to secure national efficiency as were employed by the individual. A new epoch was opening in the industrial history of the world, in which a better understanding among commercial

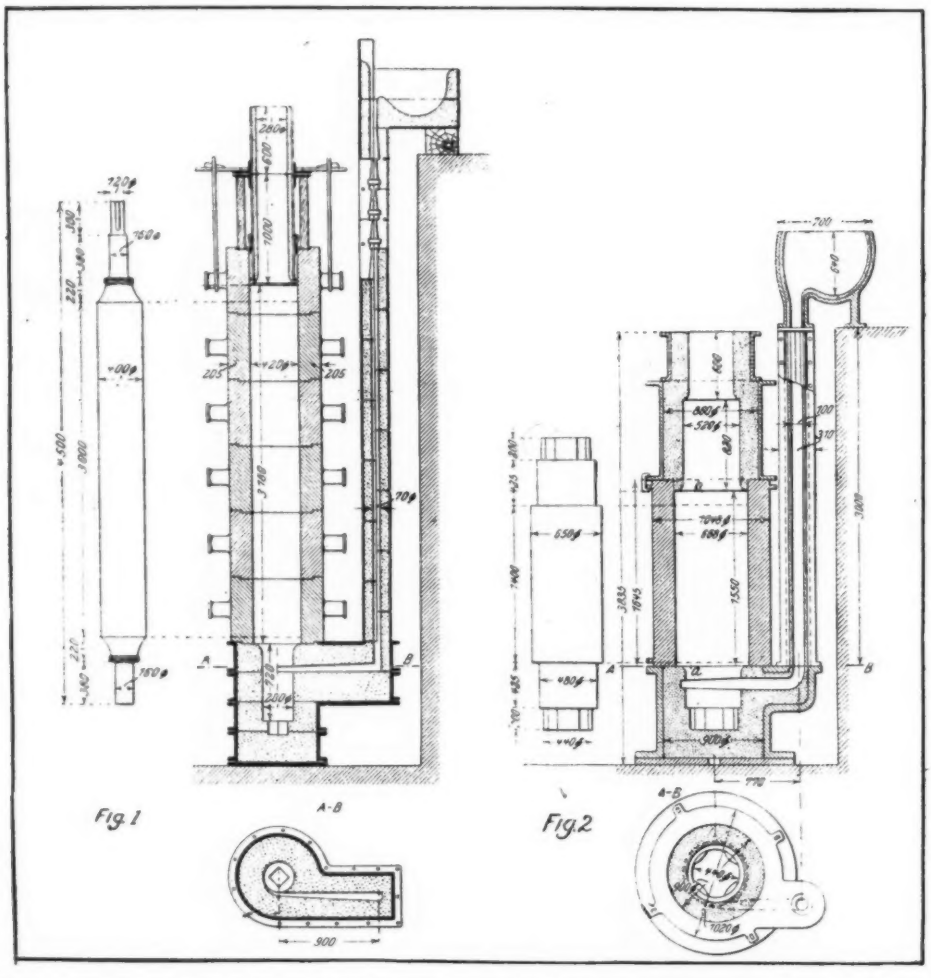
ferences in the practice compared with America, but he hoped to have the opportunity of doing that before he went home again. The reputation of British foundries, however, in America was that they did everything thoroughly and well, but that production was not at the rate so familiarly referred to in America as quantity production. British reputation, further, was that technical standards were high, higher, perhaps, than the American. Moreover, British foundries were far better equipped for quantity production than they were before the war. The industry in England, of course, has suffered far more than the American in present circumstances, because it was so much more dependent on the markets of central Europe, but when

(*Continued on page* 189.)

Application of Scientific Principles to the Manufacture of Chilled Rolls.*

By Emil Schutz.

The investigation of a number of problems relating to the manufacture of chilled rolls has recently been carried out in Germany. The factors studied include the cooling of the rolls, the heating of the chills, contraction, chill, casting strains, casting temperature, hardness, and the chemical and metallurgical properties of the castings. This investigation only covered rolls of hard iron cast in chill moulds, and did not touch on rolls of cast steel or grey iron. The rolls were cast with cupola or reverberatory furnace metal; their dimensions are extremely variable, the weight ranging normally from, say, 20 lbs. to 10 tons, though some have been made up to 33 tons. The rolls fall into two principal groups; those for paper mills, of small diameter but great length, must have highly polished, extremely hard surfaces free from pitting. The second group—for rolling metals—are large in diameter and short in length; they must have average surface hardness and a high resistance to shock. Rolls in the first group are cast from a cupola, and for the second group the metal is prepared in a reverberatory furnace. Chemical composition of the iron has an immense influence on the result.



Moulding Process.

The moulding process differs in various works, and depends on the size of the rolls; those for rolling mills, short and massive, are generally cast in chills of one piece, whilst the rolls for paper mills, long and thin, are cast in a mould built up in a series of superposed sections; in the latter case special care must be taken of the roll necks, which are liable to fracture owing to their small diameter, the greater chilling effect that they suffer and the contraction of the long roll. (See Figs. 1 and 2.) This contraction should be foreseen and dealt with by stripping the neck as soon as possible after teeming. The thickness of the chill moulds is very variable; generally speaking it is considered that the greater its thickness the stronger will be the resulting chill. For callender rolls one authority gives the thickness of the mould walls as 0.5 D, where D is the diameter of roll; for metal rolls 0.28 D is quoted. (Osann advises 0.33 D, whilst Irresberger for diameters less than 7.50 mm., 0.5 D and above 0.4 D.) For sheet mill rolls there are two groups; those for thin sheets, which get very hot in working, and are not cooled and those working on thick plates which are subjected to heavy pressure and the water-cooled. The first group must have extreme surface hardness whilst the second must be strongly resistent to shock. The hardness of the white iron skin depends principally on the cementite constituent which, in turn, depends on the total carbon content of the iron. The higher the total carbon the more the cementite tends to separate on chilling. Unfortunately, the graphite in the grey zone also tends to separate in flakes, which greatly reduces the resistance to fracture. Rolls for thin sheets are sometimes cast with a mixture of cupola and reverberatory furnace metal, a method which allows correct manipulation of the total carbon content. Rolls for thick plates are cast from furnace metal only.

* Extracted from "Stahl und Eisen."

Experimental Data.

Thirty-eight experiments were made to ascertain the rate of cooling of the cast rolls at different parts of their section. Thirty were of cupola metal and air furnace metal mixed, and eight of furnace metal. For the former the cupola metal addition varied from 32 to 50 per cent. The roll scrap charged in the furnace was always more than 47 per cent., and sometimes reached 90 per cent. The rolls were of the dimensions shown in Fig. 2. For the tests a coupon was attached to the ends.

The rolls were cast on end and special provision was made for the thermo-couple, which indicated the temperature at the junction of the upper neck with the roll body; this thermo-couple had to be applied so that it could follow up the contraction

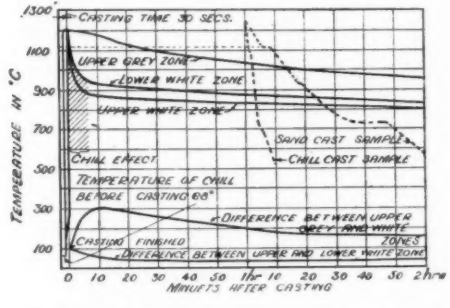


FIG. 3.—COOLING CURVES OF ROLLS. THE DOTTED CURVES ARE SAMPLES RAPIDLY AND QUICKLY COOLED.

of the roll. Other thermo-couples were placed at points where they could indicate the rate of cooling of the outer surface of the casting due to the chilling effect of the mould; the rate of cooling in the grey zone was also ascertained. The curves plotted (Fig. 3) from the temperature readings of the white zone showed a distinct kink, or break, in the neighbourhood of 900 deg. C.; this was due to the separation—owing to contraction—of the casting from the mould, resulting in much slower cooling when the hot metal was no longer in contact with the walls of the mould

Check experiments, made with white iron cast in chills and grey iron in sand showed that the point of solidification is in the neighbourhood of 1,100 deg. C. This is shown as a dotted line in Fig. 3. In the experiments this temperature was reached in the grey zone at a depth of about 4 ins. twenty-seven minutes later than the solidification of the white zone.

Transfer of Heat from Chill to Roll.

The transfer of heat from the casting to the walls of the mould was also studied by means of thermo-couples (Fig. 4), some being embedded just beneath the surface of the casting and others beneath the surface of the chill. It was found that a very short time after casting the walls of the mould had no further effect on the cooling of the casting. Five minutes was necessary for the transfer of the heat from the inner to the outer surface of the mould. The difference between these two surfaces increases very quickly during the first eight minutes, and attained a maximum at the end of ten minutes, after which it slowly diminished. It became evident that the thickness of the walls of the mould could have no effect on the hardness of the roll, or, at least, that it would be useless to increase this thickness. On the other hand the duration of contact has very great influence on the hardness, and it has been proved that test pieces poured on to an iron plate are chilled to almost twice the depth found in rolls cast from the same metal in the ordinary way; the reason being that in the first case the metal remains in actual contact with the cooling surface.

Simultaneous temperatures taken at different points in the thickness of the mould showed that equilibrium was not attained until two hours after casting. (Figs. 5 and 6.) The data furnished by these temperatures gave further proof that increasing the thickness of the walls of the mould has no influence on the hardness of the roll, because the greater part of the heat given up to the mould during the critical chilling period accumulates in the internal layers of the mould without escaping to the outer surface. Very shortly after casting the roll—owing to contraction—will not be in contact with the mould, so that a mould with walls 8-in. thick will have no greater chilling effect than one with 2½-in. walls. The thickness of the mould, therefore, is principally a question of strength and stiffness. It is obviously unsafe immediately to cast again into a mould that has just been stripped, a fact that is well known in steelworks' practice in which the ingot-moulds will inevitably fail if they are repeatedly used without being cooled. If a chill mould is used again just after it has been stripped, the internal face will attain a much higher temperature than at the first cast; the exterior surface, too, will have the same temperature as at the end of the first cast. There will thus be a much greater difference in temperature between the inner and outer surfaces, which increases the risk of fracture. The best results would be obtained by rapidly cooling the interior surface.

In the experiments described it was found that at the end of two hours the mould had attained its maximum temperature (520 deg. C.) and had commenced to cool, although the casting inside was still 300 deg. C. higher (Fig. 7). The quantity of heat radiated by the mould to the surrounding air was greater than that transmitted from the casting across the air gap between them. At about 800 deg. C. the rate of cooling of the white zone abates, and this abatement begins from the moment of solidification of the grey zone; the explanation being that the cooler white zone absorbs the heat disengaged during the solidification of the grey portion; since this solidification proceeds very slowly from the outside to the inside, the absorption by the white iron decreases progressively.

Contraction of Rolls.

It is extremely important, but very difficult, to determine the moment when the surfaces of casting and mould cease to be in contact; that is, the moment when contraction begins. According to Wüst and Turner, contraction begins as soon as solidification is complete. A method devised for detecting this moment consisted in fitting a compressed-air pipe to one of the thermo-couple holes through the upper part of the mould; so long as the casting was touching the mould the air could not escape, but the moment separation occurred the

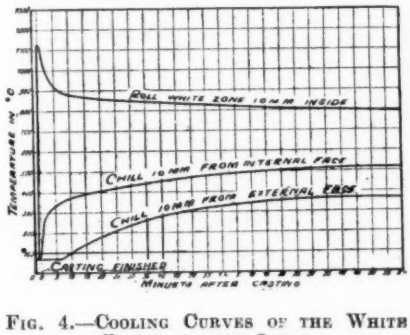


FIG. 4.—COOLING CURVES OF THE WHITE ZONE AND THE CHILL.

air could issue from one of the other holes in the neighbourhood, and its escape was detected by a small flame which it at once extinguished. These experiments had to be discontinued because it was found that the chilled surface had become converted into grey iron where it had come in contact with the entering air. Under normal conditions there is practically a vacuum in the space left by shrinkage, because the roll necks which are moulded in sand have not yet started to contract. Proof of these assertions is furnished by the fact that when there are holes to admit the air brown patches of oxide are found on the castings when they are removed from the mould. Normally the air which gradually filters past the roll necks has no effect, since the metal has cooled considerably. Measurements show that the contraction diminishes with decreased depth of chilling; with a depth of chill of 1¾ in. the contraction is 2.7 per cent. of the

diameter, and for a depth of ¼ in. the contraction is only 1 per cent., giving an average of 1.8 per cent. For a short, stout roll in which the necks are almost the same diameter as the body, the contraction was 1.2 per cent., with a depth of chilling of ⅜ in. About one-third of the rolls cast were found to be oval to the extent of about $\frac{1}{16}$ in., which amount was regular throughout the whole length of the roll. It is certain that this distortion is not in any way due to the regularity of the chilling, because rolls that were perfectly cylindrical were found with uneven chilling, whilst others distinctly oval were evenly chilled throughout. This oval distortion has persisted in spite of the most minute care in setting up the moulds, and it is a curious fact that several rolls cast in the same mould have shown the error in the same degree.

Expansion of Rolls at Ends.

It is well known that large rolls are slightly larger towards the bottom; this difference in diameter may amount to ¼ in. The minimum diameter is always found at a distance of from 2 to 4½ in. from the upper end; from there the diameter increases gradually to between 4 to 8 in. from the lower end; both ends are conical, the lower more so than the upper. In many rolls the increase in diameter is found a little below the point of minimum diameter, and remains constant to the point at which the spreading of the lower portion begins (Fig. 8). There is, apparently, no connection between the depth of chilling and the above variations in cross-section. The spreading in the lower portion of the roll may be due to the weight of the column of metal making up the effect of contraction, but this would not explain the increase in diameter which occurs in the upper portion. Although the necking down at the point of minimum diameter may be due to contraction, it is rather strange that this reduction should occur at a point where a cavity might be expected: it is thought that rolls in which this constriction does not occur may actually have a cavity at this section.

Depth of Chill.

The depth of chill has been determined from sections cut from each end of a roll cast with one riser. Measurements were taken of the entirely white zone, extending to the point where the first trace of grey iron is visible to the unaided eye; also of the white zone and the zone of transition, consisting of white and grey iron intermingled. The American Association of Roll Makers and

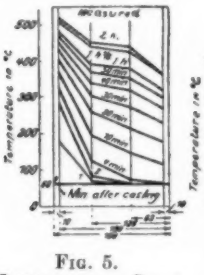


Fig. 5. Longitudinal Section of the Chill Wall.

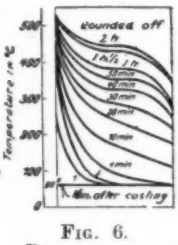


Fig. 6. Diagram of the Transmission of Heat through the Chill.

Irresberger regard as depth of chill the zone that is entirely free from uncombined graphite. Of 62 sections examined, one only was found to be evenly chilled; differences in depth of more than half-an-inch were frequently found, sometimes within a length of six inches. Sections from the upper portion of the roll were found to be much more irregular in this respect than those from the lower part. In every case the depth of chill was found to be much greater—sometimes double—at the ends of the roll body than at any other point; at 2 in. to 4 in. from the ends the chilling was normal. This arises from the fact that the necks, which are much smaller in diameter than the rolls, and shoulders offer a larger surface for the escape of the heat: this effect is particularly noticeable in metals low in silicon; further proof of this contention is afforded by rolls in which the neck is large in diameter and in which there is no perceptible difference in the depth of chilling. It is probable that this irregularity is due in some degree to the roll necks—which are cast in sand—and to the proximity of the feeding head.

Cooling Strains.

Immediately after solidification has set in tensile stresses are set up, partly from the different temperatures in the various zones and partly from the difference in the amount of contraction between the white iron and the grey. Since conditions of cooling are constant the points of equal tension are situated in concentric layers. Although the contraction of the white iron is greater than that of the grey iron, its period of contraction is almost

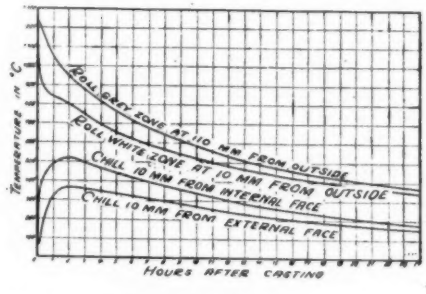

Roll grey zone at 110 mm from outside
Roll white zone at 10 mm from outside
Chill 10 mm from internal face
Chill 10 mm from external face
Temperature in °C
Hours after casting

Fig. 7.—Temperature Curves of the Roll and Chill from Casting to Stripping.

finished whilst the grey iron is still liquid. At the beginning of the solidification of the second or transition zone the expansion of the grey constituent does not produce any undue tension in the white—and already solid—zone, because the third, or grey, zone is still plastic. The contraction of the white zone, therefore, is continuing simultaneously with the slight expansion of the transition layer, resulting in a slight compression decreasing inwards and corresponding to the pressure exerted by the still liquid column of metal. As the contraction of the first zone continues slowly that of the second zone is reaching its maximum, whilst the third zone is expanding inwards. The contraction of the second zone is then so strong that it no longer exerts any pressure outwards; the tension in the first zone has now disappeared completely, and the distribution of stress is, in the first zone, no tension; second zone, slight tension; third zone, slight compression diminishing towards the centre. During the following period four zones and a liquid core can be distinguished. The first zone cools and contracts ever more slowly without hindrance from the second zone, which contracts more quickly than the first. Contraction of the second zone is opposed to some extent by its adhesion to the first, which causes tension in the second zone, leading, in turn, to slight compression in zone 1. Zone 3, at the period of maximum contraction, is opposed by zone 2, which determines its diameter. A strong tension results which stresses the external layers in such a manner that from the outside towards the inside would be encountered a compression which fades to zero and is transformed into a tensile stress in zone 3, which to effect its contraction draws on the metal from zone 4, the expansion of which takes place outwards without exerting any pressure on the core. As the cooling continues shrinking takes place from the interior outwards with powerful tension in the still liquid core; when the core has solidified the continued contraction sets up such tensile stresses in the core that they may be sufficient to cause a rupture resulting in a cavity. So, when the roll is quite cold there is an exterior zone of compression decreasing to zero; then a zone in tension which increases to the point of rupture at the walls of the cavity or at the axis of the roll. The presence of these zones of tension has been proved as follows; on a turned section of the roll two points were marked on the same diameter and at, say, 4 in. apart; a portion of the disc was then cut away, when it was found that the holes were sprung inwards with great force. Without being able to establish any law on this subject, it may be

said that on the majority of sections tested the amount of this contraction depended on the depth of the white zone.

There is a great diversity of opinion on the question whether the metal should be hot or cold when cast. Two rolls were cast with metal from the same ladle, but one was poured at 1,320 deg. C. and the other at 1,220 deg. C.; it was found that the hotter metal resulted in a much smoother surface, whilst the depth of chill was the same in both cases; after machining, the hot-cast roll was dark and as lustrous as mercury, whilst the other was lighter, with a matte surface covered with fine lines like a cobweb. Micrographic examination gave no indication of this difference in appearance. By casting the metal hot, a much better surface is obtained, and, at the same time, there is less risk of the formation of "cold shut"; it is, therefore, recommended that the metal should be hot.

Influence of Composition.

So far as chemical composition is concerned, analyses have led to the following conclusions. The total carbon alone has no influence on the depth of chill, which is also unaffected by the content of manganese, phosphorus, and sulphur. The silicon content diminishes with the depth of chill, as does also the proportion of graphite in the grey zone. The total carbon content is always much higher in the white than it is in the grey zone; silicon is irregularly distributed in the two zones; manganese and phosphorus in the majority of rolls are slightly higher in the white zone, whilst the sulphur is always higher in the grey zone. The total carbon content varies considerably in the upper and lower

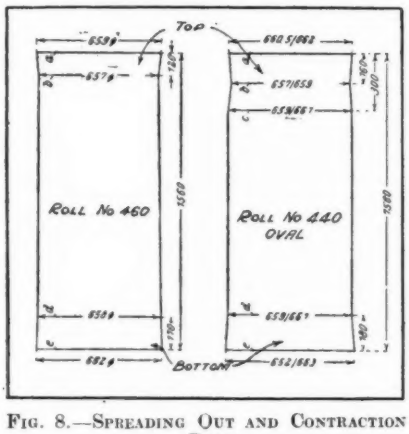


FIG. 8.—SPREADING OUT AND CONTRACTION OF ROLLS.

portions of the roll, as well as in the white and grey zones, but there is no regularity in the variation; this is also true of the graphite in the grey zone. Silicon and manganese are evenly dispersed in both top and bottom portions. The phosphorus and silicon in the grey zone are slightly greater in the upper portion. It must be remembered, however, that it was not possible to take samples for analysis from a depth greater than 2 in., otherwise the roll would be rendered useless. Since, even at this slight depth, a slight concentration of phosphorus and sulphur was observed, it is certain that considerable segregation is present at the core.

Microscopic Researches.

Microscopic examination shows that the zone of white iron passes progressively but irregularly into the grey zone. Sections taken further and further from the surface show the gradual transition to the normal structure of grey cast iron. The flakes of graphite are larger in rolls high in carbon. The phosphorus, which averages 0.5 per cent., is nearly always present as the phosphide eutectic with a freezing point round about 922 deg. C. Since the mass of material has solidified long before this temperature, the phosphorus alloy is found between the other crystals. Sulphur appears partly in the form of fine crystals of iron sulphide as needles or stars, or as patches of manganese sulphide; these crystals occur throughout the casting, very small in the white zone but larger and more numerous at the core. A careful comparison of the microscopic structure reveals no fundamental difference between one roll and another any more than it reveals the difference between hot- and cold-cast metals. As a consequence of the internal pressure resulting from solidification of the metal the low-melting point phosphide eutectic, previously mentioned, is squeezed out and forms a sort of crown on the shoulder between the body of the roll and the neck. This alloy is squeezed out whilst still liquid in the form of drops and needles, which adhere weakly to the surface of the shoulder. Their position indicates that the roll casting had already shrunk sufficiently to allow of their formation in the space between mould and casting.

Conclusions.

As a result of the research the following conclusions were reached. The thickness of the walls of the moulds has no influence on the depth of chill because of their poor conductivity; the thickness is settled by the stiffness and strength they must have. Contraction of the cast roll is not regular; it is necessary to allow for oval distortion to the extent of 2.7 per cent. of the diameter. The greater the depth of the "chill" the greater will be the contraction. Large rolls with necks of small diameter are chilled to a greater depth than rolls with thick necks. The ends of the roll are often chilled twice as deep as the rest of the body; this must be taken into account when machining. The metal must be cast hot. The depth of chill cannot be influenced by the carbon content but only by the silicon content. A high carbon content (within the usual limits) results in the separation of larger flakes of graphite than are formed with a lower carbon content: this means that the resistance to fracture is lowered.

Correspondence.

Involute Gearing.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I was much interested in the paragraph dealing with this subject in the series of papers on "An Apprenticeship Course in Foundry Practice," by Messrs. Shaw & Edgar, which appeared in your last issue.

The method of explaining involute gearing adopted in Fig. 4 is one which appeals to me as being particularly suitable to make clear to the student not only the formation of the tooth outline, but also the reason why the outlines work together in perfect relation.

The argument, however, can be carried somewhat farther than is indicated in the article, and it may be of use to those of your readers who are following this subject to know this.

Suppose that in Fig. 4 the line representing the cord is designated by P at its point of contact with Circle B and Q at its point of contact with Circle A—these Circles are the "Base Circles," not the "Root Circles," as stated in the article—and a pencil is fixed to the cord at point P. Then if A is made to rotate contra-clockwise, the pencil will describe on the base-board the line PQ. On an extension of wheel B it will describe an involute curve. On an extension of wheel A it will describe another involute curve. If we can imagine the pencil doing these three things simultaneously, then obviously the two involute curves will be in contact always at a point on line PQ, and if these involutes are made the outlines of teeth on their respective wheels, these teeth will give precisely the motion obtained from the cord. The line PQ is therefore the "line of action" of the gear, and that portion of the involute curve lying between the base circle and the addendum circle (that is, the circle containing the points of the teeth) constitutes the ordinary working tooth profile.

If the student will rig up for himself a small model on these lines he can actually construct the outlines of wheel teeth in this way, and see in concrete form how the two outlines interact.

A similar method can be adopted in the case of cycloidal teeth, using pitch circles and rolling circles, and here the arcs of the rolling circles form the "line of action" between the teeth.—Yours, etc.,

J. A. CORMACK.

34, Langdale Avenue, Mitcham.
August 24, 1923.

A New Long-Life Mould Development.*

By Dr. Richard Moldenke, Watchung, N.J.

The foundryman has always felt that the destruction of the mould every time a casting is poured is an inefficient procedure. Indeed, the making of moulds which could be used over and over again dates back to the bronze age, when implements of warfare and domesticity were made in stone moulds the two parts of which were suitably hollowed out, clamped together and poured much as our present brass ingots. These stone moulds are in reality the first " long-life " moulds on record. In the development of the iron industry, with molten metal at first only as an undesirable occurrence in the operation of the small blast furnaces used, the open-sand mould was the only practical means of caring for the intermittent supply of metal. As time went by, however, and the iron foundry became stabilised, the desire to construct moulds which would last for more than one filling without damage asserted itself again and as early as the opening of the last century we have British patent records bearing upon the subject.

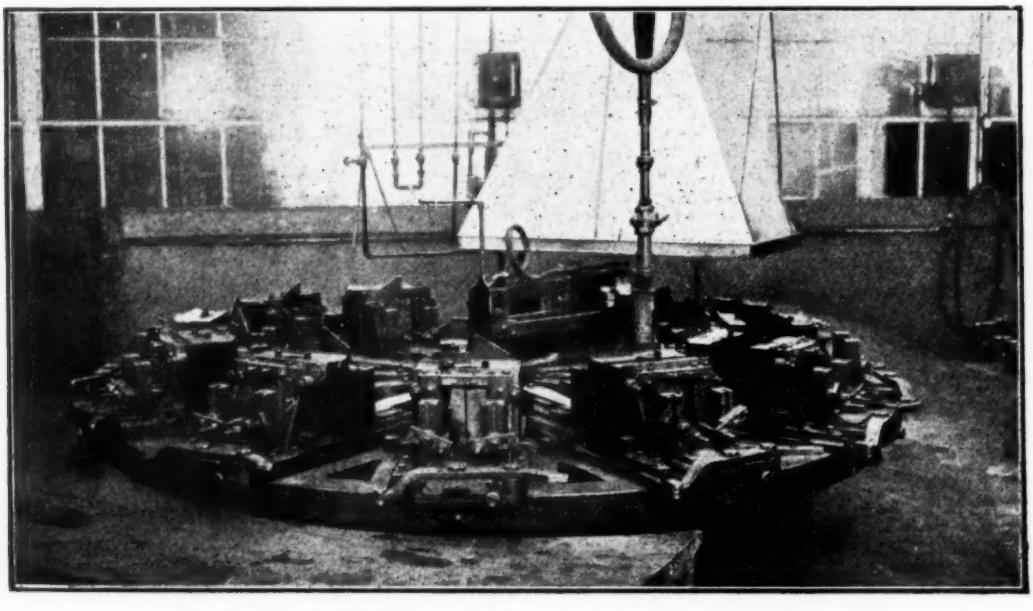


Fig. 1.—A Group of Long-Life Moulds arranged on the Revolving Table.

While the iron mould—or as we know it under the title of " permanent mould "—has been known and used for perhaps a century and a half, and is to-day attracting world-wide attention in connection with the centrifugal casting process, the method in its simpler forms has never found a solid footing in the foundry industry, the fundamental reason being that the molten metal when poured into an iron or steel mould is subjected to entirely different influences than is the case with the ordinary sand mould. The rate of cooling is so much faster, with consequent more sharply defined crystallisation effects and production of very fine grain structure if not actual chilling of the metal to whiteness. Even where the attempt is made to approximate the rate of cooling as in the sand mould, by suitably pre-heating the iron mould, this either falls short of the desired situation if the mould is to last, or when preheated sufficiently pouring must be done at longer intervals unless the life of the mould is to be sacrificed. The consequence has been that while good castings have been made with all the permanent mould processes brought out, the irregularity of product unless corrected by careful and costly annealing has militated against their commercial success.

For ordinary work, therefore, it seems far better to return to the old bronze age idea of using the equivalent of the stone mould—in other words, a mould of the refractory surface properties of sand and yet sufficiently strong to yield a large number of acceptable castings before considerable redressing is necessary or the mould must be discarded. This would be the " long-life " mould. Coming down to practical considerations, the following conditions would seem to be indicated in developing such a type of mould.

Conditions to be Considered in Developing Long-Life Mould.

The mould surface must be of a highly refractory character so that the least possible heat may be transmitted inward to affect the form of the mould as well as seriously limit the rate of pouring iron for castings into it. If too much heat passes from the surfaces in contact with the molten iron into the body of the mould, the very purpose of the mould is lost, as it no longer will approximate the regular sand mould. Again, a too-hot mould will warp and deteriorate rapidly. Hence the desirability of having the mould light and if necessary air cooled, so that the mould body may not accumulate heat unduly and thus affect the rate of pouring detrimentally. The ideal situation is that of the heat conditions in the green-sand mould from which the casting has been removed just after setting—imagining this possible without destroying the mould. But a very small depth of sand will have been seriously affected by the extreme heat, and the outer portions of the mould may still be cold.

The nature of the mould material must be such that no gases are formed during contact with the molten metal until this has set. There is little chance for venting in such a mould. A momentary consideration of this matter, however, will show that after all it is the fault of the mould if gases are formed which affect the metal surfaces. The chilled roll is a case in point. Here is no chance for venting whatever, and yet castings are made which machine up without a defective speck. Further, it is perfectly possible to cast against a firebrick surface successfully, provided the surfaces are perfectly dry and preferably warmed. Hence, if the casting surfaces of a long-life mould are of a finely granular and highly refractory nature there need be little fear of bad results due to lack of venting.

The mould surfaces must be sufficiently strong to resist the cutting action of the molten metal, and be impervious to the entrance of fine filaments of iron which on removal of the casting would take some of the mould material with it. Further, the

* Paper presented before the American Foundrymen's Association, Cleveland Meeting.

mould surfaces must not spall off. If thoroughly dried the last-named action should not eventuate. The strength of the mould surfaces is a question of the bond, and the porosity of the material a matter of the fineness of grain or crystal.

Rate of Removal of Heat from Molten Metal must be Considered.

The crucial point in the above considerations as to the nature of a desirable mould surface is the rate of removal of heat from the molten metal—whether as slow as in the case of the ordinary sand mould, or sufficiently fast to permit some chilling action. This rate of removal of the heat until the molten metal has safely set depends upon the refractoriness of the material in greatest measure, the temperature of the molten metal and quantity of metal involved, as also the freezing point and other metal characteristics. For the various sections of a casting the temperature of any point of contact between mould surface and molten metal will be practically the same at first, but the depth to which the comparatively high temperatures will penetrate the mould mass will naturally depend upon the thickness of the metal which has to set against it. Thus, if in a casting that portion ¼ in. thick imparts, say, 500 deg. C. to a point 1-64 in. within the mould mass, another portion of the same casting, 2 in. thick may show the same 500 deg. C. at a point 1-16 in. deep within the mould mass before the metal has safely set. Practically for "long-life" mould purposes, it is the nature of this 1-16 in. or less depending upon the thickness of the castings to be made, that must be carefully considered and conform to the requirements above enumerated. The rest of the mould mass can be any material that is structurally safe to hold the refractory surface true and well bonded, and will also absorb the heat passed through the mould surface material and promptly dissipate it. In other words, a cast-iron backing to a refractory mould material forming a contact surface for the molten iron, is an ideal combination when the refractory facing of the mould is sufficiently heavy to transmit heat at the proper safe rate, and the iron backing is light enough to dissipate the heat transmitted into it quickly.

A Practical Long-Life Mould.

With the above underlying principles involved in the construction of the "long-life" mould thus enunciated, it is the purpose of the writer to show how the problem of adapting these principles for everyday practical application have been worked out into a system by the Holley Carburetter Company, of Detroit, and to show illustrations of the machines built for the purpose. When it is stated that by this time some of the moulds have already had ten thousand castings made in them and by reason of a close daily inspection of and attention to the refractory facing material of the moulds not one of them has yet had to be discarded, the writer feels that here is truly a new development in making long-life moulds. The term "long-life" is used advisedly as against "permanent," for in the latter the supposition is that no repairs are made on the metal mould; whereas in the former, repairs are possible and are carried out until they no longer pay.

The system devised by the Holley Carburetter Company has been carefully worked out in every detail and is fully patented. The several steps and the reasons for operating just that way are given in the following:—As previously indicated, the primary idea has been to make a very light cast-iron mould, the surface of which is covered with a layer of highly refractory material, of necessary thickness, and this refractory material so protected from abrasion and penetration of fine iron filaments, that it almost wears to a polished surface and only on rare occasion needs to be patched up or refaced. For operating purposes, where the castings are not large, a group of moulds are placed upon a revolving table and the several steps of the cycle can be carried out almost completely automatically. Where the castings are larger and a table of three to eight moulds would be cumbersome, single moulds would be operated as long as molten metal is available.

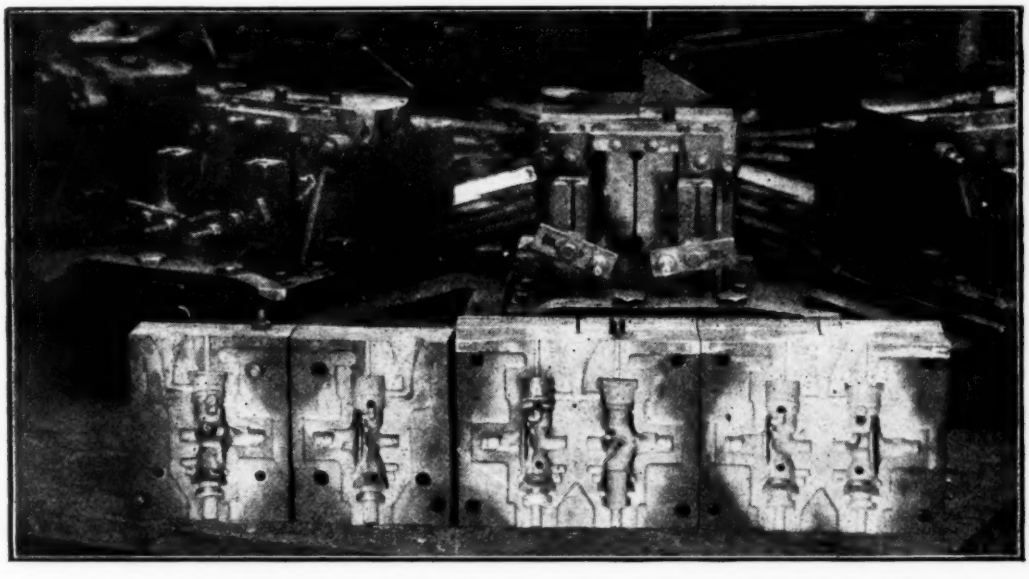


FIG. 2.—A CLOSE VIEW OF THE OPEN MOULDS. A CORE HAS BEEN SET IN THE THIRD MOULD FROM THE LEFT.

Refractory Material Forming Mould Lining.

The refractory material forming the mould surface consists of two items, the refractory material itself, and the binder to bind it to the iron backing. The refractory material can be any of the usual substances used to resist heat in the arts. Thus, magnesia, bauxite, fire-clay or kaolin will serve. The grain must be exceedingly fine and in the application heat must be used finally so that no question of gas-forming constituents remaining in the mass may arise. The binder must be a mineral one, an alkali silicate being most convenient, so that when heat has been applied the mass is like a thin sheet of stone. The material is preferably put on in comparatively thin layers, and each one baked on before the next is applied. For the heavier facings, the final layers can be applied by transfer from what would be a metal pattern, so that the accuracy of the finished long-life mould leaves nothing to be desired.

Moulds can be Operated on Revolving Table.

The final heating—in effect a skin-drying at temperatures almost to vitrify—being accomplished, the moulds are placed in their proper position on the revolving table, and successively follow their

prescribed course. In passing around, the two parts of the mould are drawn apart sufficiently to allow the setting of cores, but just before this each mould successively passes a flame of acetylene gas which smokes the inner surfaces heavily. The idea of this is to interpose a film of carbon between the refractory surface and the molten metal of sufficient strength to effectively prevent any scoring action or the actual contact of metal and refractory material at the instant of greatest temperature effect.

Most of the carbon is absorbed by the metal, but the effect is that until the molten metal is no longer dangerous, the refractory material is protected. After passing the flame and the position where cores can be set, the two parts of the mould are made to close automatically and are held thus until poured off and the metal has sufficiently set. Then they quickly open and the castings are forced out by pins or in other suitable ways.

Cooling and Cleaning the Moulds.

Next, a blast of air at high pressure rapidly blows the surfaces clean and the mould passes before the acetylene flame again. The man setting the cores, or in his absence, any attendant watches out for the mould surface condition as the moulds pass by open, and any fragment of iron or core left in the mould is easily removed with a suitable tool.

The iron backing of the mould has been stated as comparatively thin. This allows—particularly if constructed with that in view—the use of air-cooling action. Where such an air blast for cooling the iron moulds a little faster than they would normally is in use, the machine can be speeded up and thus give a larger production.

Method of Pouring.

Whether pouring is done by hand or from suspended ladles; whether the man remains stationary while pouring as the mould passes him or a moving platform accompanies the table; whether the moulds and cupola are together or iron has to be carried from a distance; and lastly, whether moulds are poured all day long or merely the usual two or three hours, depends upon the individual situation. It may be of interest to state that with twelve single moulds on the revolving table, one man can pour 400 castings of a given kind per hour. With sand castings it takes eight times the number of man-hours to get an equal number of the same kind of castings. Further, from the nature of the pour —top-pour—it is possible to feed the moulds much better and hence the castings made are quite free from shrinkage even with considerable variation in sections. This makes for denser metal and the consequent benefit to strength conditions and wearing qualities.

Method can be Developed.

While the process is still in its infancy and attention has naturally been given to quantity production of the comparatively light castings required at the Holley Carburetter Works, nevertheless many automobile pistons have been made also, and these involve somewhat thicker sections. It will become a matter of heavier refractory coatings, and more frequent repair of exposed points in these coatings, when larger work is undertaken.

Construction Features.

Of the illustrations given, Fig. 1 shows a group of long-life moulds arranged on the revolving table and ready for the pouring operation. Directly at the right end of the wooden platform, the mould will be noted just closing up. The next five moulds will be seen as closed. Pouring is done while the moulds pass the wooden platform. The metal sets properly while the table brings the moulds successively to the position of the one under the last pipe at the lift, where the moulds open for the ejection of the castings. At the next position, toward the right, the mould face is blown clean, then it comes before the acetylene flame as seen directly under the hood. Here the mould face is smoked, the excess smoke being drawn away with the products of combustion. The moulds are now wide open and at the extreme right of the table three moulds can be seen fully open for inspection and the setting of cores. The cycle then repeats itself.

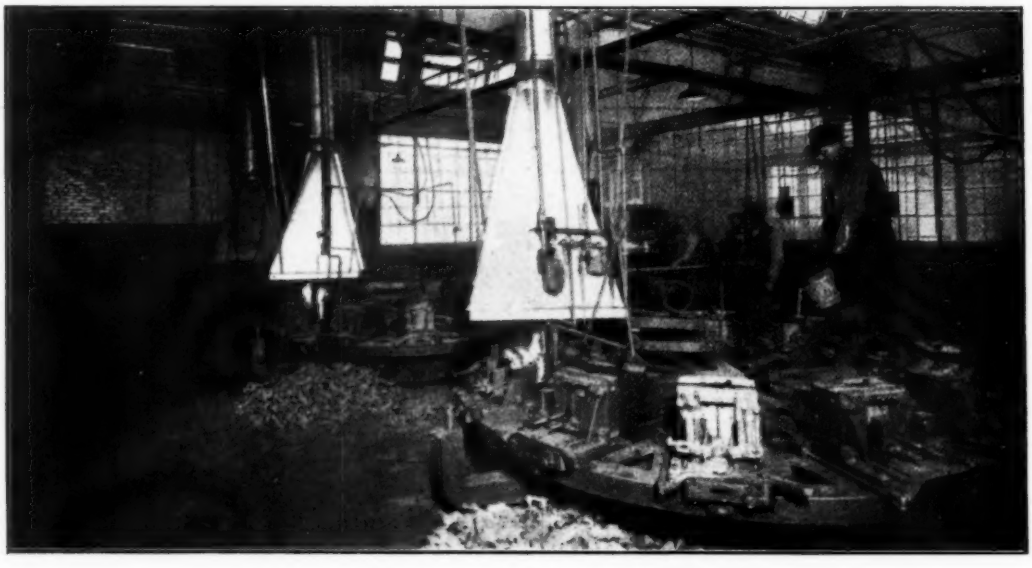


FIG. 3.—TWO POURING TABLES IN OPERATION.

Fig. 2 shows the moulds more plainly and also has placed in the foreground a set each of a one and a two-casting mould. The arrangement for pouring basin, core vents and gating is plainly shown. A core has been set in the third mould from the left. The holes in the moulds directly in the spaces for the molten metal are filled with suitable pins which push inward as the moulds open and thus eject the castings automatically.

Fig. 3 shows two of the tables in operation. Pouring off may be observed on the first table, and the smoking of the moulds on the first and second. Successful results have also been obtained by spraying the moulds with a film of graphite in oil, the heat of the moulds driving off the oil almost immediately. This method would doubtless be more economical for larger moulds.

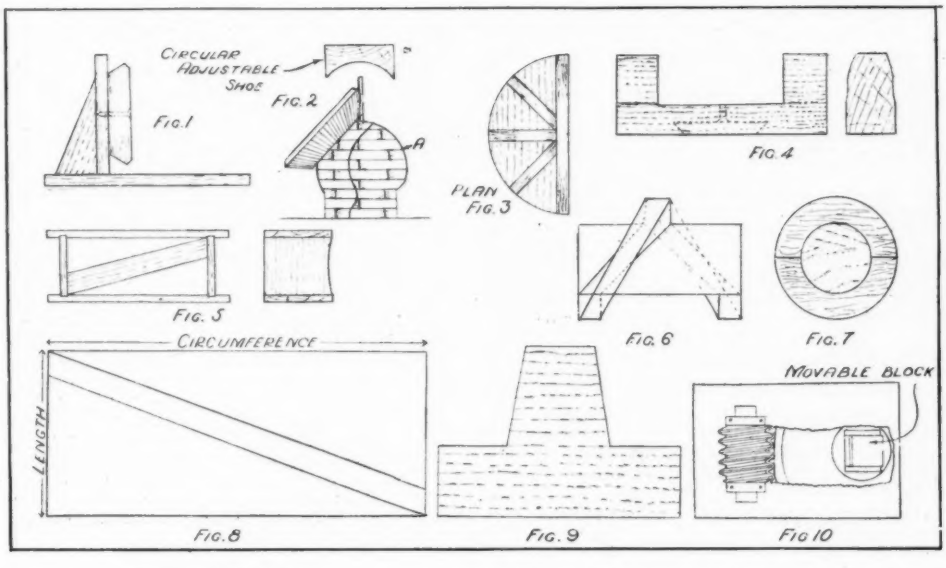
The principles involved have also been discussed by the writer, but until the Holley Carburetter Company had worked out the problem step by step and had provided for the several contingencies mentioned in connection with the requirements of the mould surface, nothing comprehensive in this line had come before the foundry industry.

An Apprenticeship Course in Foundry Practice.—LVI.

By Ben Shaw and James Edgar.

THE CONSTRUCTION OF WHEEL PATTERNS.

We have refrained almost entirely in this series from describing specific patternmaking or moulding jobs, believing it better to explain principles accurately and only give illustrations of work when it was impossible, or exceedingly difficult and unsatisfactory, to describe the application of such principles. The subject of wheel construction is sometimes treated as though it were in all respects different from other patternmaking, which is not strictly correct. We have discussed the jointing of timber and the various methods of building work in previous articles, and what has already been said about segmental work, about taper and contraction allowances, is equally correct with regard to wheel construction. It is in the formation of the teeth and the methods of joining them to the rim that the real difficulties lie.



Alternative Methods.

In making a straight tooth pinion or a bevel wheel, the pattern may be made, teeth included, from a solid block of timber, the teeth may be glued and nailed to the periphery or they may be dovetailed to it. The first method is only suitable for small wheels, but it is a very good method if only one or two castings are required and those urgently. It is essential that the timber used should be very dry, and it must be joined so that the end grain is on the faces of the bosses, then if the pattern shrinks, the shrinkage of all the teeth will be uniform. Bevel and mitre wheels especially are often made in this way, and if carefully varnished quite a number of good castings can be obtained from the pattern. When the periphery has been turned it should be divided according to the number of teeth while the pattern is still in the lathe. It is sufficient to divide one edge or a line marked with a scriber while the lathe is revolving. The lines can then be squared over or a surface gauge may be used from the bed of the lathe. If, owing to the size of the wheel, this is impossible, it can be removed from the lathe and fastened to a vertical support erected on a level board on which the anvil of the surface gauge can rest (Fig. 1). The centre lines should not be used as centre lines, but as lines representing sides of the teeth.

Cutting Bevel-Wheel Teeth.

The cutting of bevel-wheel teeth which are made from the solid is facilitated by the use of a simple jig. As a bevel wheel is a frustum of a cone, the sides of the teeth all radiate to the centre of the cone. It follows, therefore, that the teeth of a bevel wheel can be sawn at the band saw if the pattern is so located that the apex of the cone is at the point of the teeth. A convenient form of jig is shown at Fig. 2. It consists of a spherical shape A on a base, and, if it is built up segmentally, it will retain its shape for a long period. No screws or nails should be used when building the sphere, because it has to be band sawn to the centre after it has been turned. In making an entrance for the saw, it is better to give a curved cut to the centre. Sometimes a less elaborate form of jig is made consisting of a semi-sphere constructed, as shown at Fig. 3, of a face plate and two or three section pieces, but if wheels are frequently made the full sphere is much better. To prevent the jig moving from its correct position a piece of wood which fits into the recess of the table should be secured to the jig. The diameter of the spherical portion of the jig depends upon the size of the wheels that are being made and also that are likely to be made in the future. It is convenient to make the diameter smaller than the vertical height of the centre of the wheel from the plate of the pattern. When the gear pattern is turned up and ready for the teeth to be cut, a shoe can be made to ride on the jig, its thickness at the centre being such that when it is secured to the plate of the pattern and in contact with the jig, the conical centre of the pattern and that of the sphere will coincide. A jig of this type can be used for different sizes of bevel gears by varying the thickness of the shoe so that the pattern is maintained at the required distance from the centre of the sphere.

Fixing Teeth.

In all but small wheels the teeth are made separately and then fastened to the rim, each tooth being set with its edge along one of the spacing lines drawn on the rim. When dovetails are employed, the dovetails are fitted to the rim separately and afterwards secured to the teeth. The dovetails should be made of hardwood. It is very seldom that teeth are dovetailed nowadays, because it is a very costly method. After the dovetail has been neatly fitted, square blocks are glued and screwed to them. These blocks should be kept sufficiently wide that there will be practically no space between the teeth because both rim and sides have to be turned in place, and there is always the risk of the teeth being torn off. The whole

of the teeth are set out separately. Great accuracy with regard to pitch is obtained in this way. When the teeth are made in a box, as described later, the top of the box should have a centre line marked on it, and this should be transferred to each tooth after it is finished and before it is removed. Some craftsmen test the pitch with the callipers at the points, but it is a much superior way to test with dividers to centre lines.

Tooth Box.

It is obvious that it would be very tedious work to mark off and finish every tooth separately. This is seldom done. When the teeth are cut from a solid block, a template is used to draw the profile, and when they are made separately a jig is employed. A common form of jig is shown in Fig. 4. Variations of this jig are used for bevel gears, and sometimes it is dovetail-slotted as indicated by the dotted lines to slip on to a dovetailed base which is held in the vice. When the teeth are sufficiently large they are secured with a screw, but in the case of small teeth sprigs driven in and filed sharp so that the tooth blocks can be pressed on to them hold them quite rigid while they are being planed. Care has to be exercised when planing the teeth or the jig is usually spoiled. A roller may be turned with a centre recess covered with sand paper and of a length so that the tooth jig rests on the ends which are not covered with sandpaper. When the teeth have all been planed they can be inserted in the jig again and centred on the roller revolving between the lathe centres.

Another method that is not uncommon is to make the teeth in sections, three or four teeth on each section. If a wheel with twenty-four teeth was being made, six segments might be made. These segments would be screwed to the rim, turned in place and the teeth marked off either separately or with a template. The thickness of the rim attached to the teeth would not be more than $\frac{1}{4}$ in. or $\frac{3}{8}$ in. This is a compromise between the dovetail and separate tooth methods, and is specially good for small standard patterns when the teeth are too small to have dovetails.

Helical Wheels.

In making helical wheels the same procedure is adopted when setting out the teeth proper, but the teeth cannot be finished away from the rim. A box similar to Fig. 5 must be made, the radius of the ends corresponding to the radius of the wheel rim. The teeth should either be glued on the rim and finished in place, or a block corresponding to the rim may be made sufficiently wide to take several teeth, which can be transferred to them after they have been finished to shape. Double helical wheels are parted across the middle of the teeth, as the moulder has to screw each half out of the mould. Worm wheels are split in the same way.

When making straight teeth it is usually advantageous to make several teeth in one length, but it is not possible to do so when making helical or worm gears. Before any set of wheels leaves the pattern shop they should be tested in mesh, and it is better that there should be slightly more than the theoretically correct clearance. The moulder—even when a first-class pattern has been made—must rap the pattern to safeguard against the sand between the teeth breaking off, and this rapping makes the teeth slightly larger, hence the reason for finishing them to slightly under size. A few spare teeth have also to be sent to the foundry as, even when great care is taken in withdrawing the pattern, some corners get broken off and require to be made up.

Worm and Worm Wheels.

We shall now proceed to a brief consideration of worm and worm-wheels. Similar to a worm, in that it is a screw, is the conveying screw illustrated in Fig. 6. We may regard it, from the foundryman's point of view, as the simplest form. The pitch is extremely coarse. Fig. 7 shows the simplest form of construction. A cylinder is first turned and over this cylinder are fitted two half-diameter "bushes," the outside being turned to the diameter of the point of the thread. Instead of developing the shape on the wood, paper templates are drawn for both the inside or root of the thread and the face of the thread. The templates are the same length as the cylinder and the widths equal the inner and outer circumferences respectively. Fig. 8 illustrates one of the templates. These are glued to the pattern. The thread can be sawn roughly at the band saw and finished at the bench. This method is applicable to an ordinary worm if the pattern is urgently required, but for a standard pattern it is not as strong as a worm built or cut out of the solid. Small worms are invariably cut from the solid. A cylinder is turned, the thread developed in a paper template the full length of the worm, and a template like Fig. 9 is used. The thread may be sawn at the circular saw with the aid of a suitable jig, or a tenon saw may be used with a stopper piece clamped to the blade, which serves as a depth gauge. The teeth are finished with gouge and chisel, and it is more convenient to finish it in the lathe when it is swinging between the centres.

While the paper template, on which diagonal lines are drawn corresponding to the pitch of the worm, is satisfactory for comparatively small works, it is not suitable for large patterns which have to be built segmentally or with staves. As it is easier to make the worm-wheel suit the worm, the worm pattern is usually made first. A cylindrical barrel is first built in the ordinary way with grounds and staves and in halves. The diameter of this barrel is the diameter of the root of the teeth, and on it are built segments which have previously been shaped in a box of the type shown in Fig. 5. The segments are made the width of the thread at the root, and when staves are used they are fitted close together 2 to 3 in. thick, and the helix drawn after the outside has been turned. At the ends of a worm the thread finished off is sharp, and this, to facilitate moulding, has to be rounded off.

Cutting Worm-Wheel Teeth.

When making worm-wheels there is only one practical method, which is to glue tooth blocks in place, turn them accurately, and shape them with a space template. When the worm-wheel teeth have been finished with the template the worm and wheel will not mesh until the points of the teeth have been reduced to give clearance. There are several ways of doing this, but nothing beats the practical way of working the two in the same relative positions as the castings will be. A jig may be made similar to Fig. 10. Slavish adherence to this particular jig is, however, not enjoined, and there are modifications of the same principle which are equally good. The wheel, a segment of which only is shown, is mounted and revolved past the worm, the worm also being arranged to revolve by having grounds or bearings under the core prints. It is advisable to set the wheel so that it can be brought up to the correct position gradually. Colouring of some kind is used as a marking. It will be noted that in the jig shown in Fig. 10 the wheel is secured to a square block which fits into a frame which only allows it to move forward until the gear is perfect. As Fig. 10 is a plan this block ought to be dotted, but it has been drawn full so that the reader may see clearly what is intended.

The pattern store at the Blantyre Engineering Company's works in Forrest Street, Blantyre, has been practically gutted by fire. The roof of the moulding shop adjoining was also damaged.

It is understood that several shipbuilding yards will be closed down during the next week or two. The Cleveland Shipbuilding Company, Limited, who took over the yards of Sir Raylton Dixon & Company, and W. Harkness & Son, Limited, at the beginning of this year, have not yet commenced operations, and both yards are still closed, and the new yard of Wm. Gray & Company, Limited, at Seaton Carew is practically idle. Smith's Dock Company, Limited, acquired a site several years ago for the extension of their establishment at South Bank, but up to the present conditions have not been propitious for making a start. Similarly, early this year, Swan, Hunter & Wigham Richardson, Limited, acquired a site for a new yard at Teesport, on the south side of the river, adjoining the site which has been taken for docks and wharves by the London & North-Eastern Railway Company, but in neither instance does there appear to be any likelihood of an early commencement of operations.

Defects in Jacketted Exhaust Pipes.

By S. G. Smith, M.I.Brit.F.

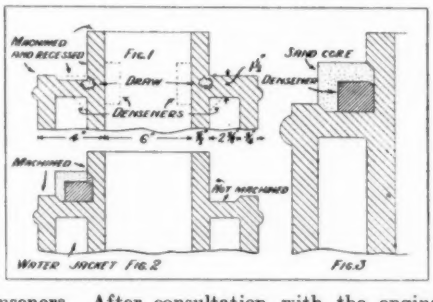
Jacketted exhaust pipes are used to exhaust the spent hot gases from the cylinder after ignition between the cylinder head and piston of the vertical tandem type of gas engines, hence they are subject to a very high working temperature.

Fig. 1 shows one end of the casting only, because it is in this end of the casting the defect to be dealt with occurred. The castings are about 3 ft. long, varying in section, bore, and weight. The defect occurred only on those exhaust pipes which, as shown in the figure, have an expanding joint, entailing an extended spigot, also shown. The exhaust pipes, of which some are made without the extended spigot, do not, without exception, show the defect. This defect is a porous draw, and is not discovered until after machining.

The castings are made and poured horizontally, hence the location of the porosity is invariably in the top half of the casting. Feeding by rod fails to cure this defect, as also does the internal application of denseners in the bore and jacket cores near the defective part shown by dotted lines in the figure.

How the Defect was Cured.

It will be seen from Fig. 1 that where the casting has to be machined the tool cuts into and exposes the porous places. The exhaust gases would further penetrate such porous areas, and this defect would be sufficient to scrap any castings of this type. After the failure of the denseners applied in the bore and jacket core to cure the defect, it occurred to the writer on further consideration to reduce the machining allowance, and if possible to eliminate the necessity of the recess being machined. This was to be done by the substitution of a core or radial



denseners. After consultation with the engineer concerned, it was agreed to proceed on the lines suggested.

In order to make a radial densener effective in the neck of the casting, it is evident, as will be seen from Fig. 2, that the denseners cannot be easily liberated from the casting. Hence to overcome this a combination of densener and core was adopted, and the densener was put into the core-box forming the core with two faces of the densener exposed to the parts that would be porous. By this means, when the sand forming the outside of the core was removed, the denseners fell away quite freely, leaving the chilled portions quite sound. Additionally, no machining was necessary at the parts formed by the combined core and densener. This is made clear by examining the right- and left-hand views of Fig. 2. It must be understood that, although not essential, the denseners in the cores were carried around the complete circle in order that the outline of the casting at these parts would be uniform.

Fig. 3 gives an enlarged view of the section under consideration. The circle is divided into 4 or 6 segments as shown in Fig. 2, and held in position by the usual means. This involves that only a small segment core-box is needed. A print, of course, is carried around the circle of the pattern, into which the cores can register. The plan adopted was simple, inexpensive, and completely eliminates the defects.

THE IMPORTS of foreign iron ore at the Senhouse Dock at Maryport last week amounted to 6,500 tons.

Another Direct Process.

Mr. T. Levoz, writing in "La Métallurgie," states that he has invented a method of making iron direct from the ore. There are three distinct but continuous phases, all taking place in a furnace with an extended hearth, which is inclined and really consists of several hearths. It is claimed to allow of both desulphurisation and dephosphorisation, if such are necessary.

1st Phase.

Briquettes made up of iron ore, carbon, lime or limestone, low melting point flux and bauxite, or other silico-aluminous material. As a result low carbon iron is obtained together with a fluid slag. The presence of the low melting point flux allows the slag to be drawn off at a temperature lower than that of the bulk of iron and its oxides. The iron oxide is not taken up by the slag because it is reduced immediately. The necessary temperature is reached in the charge (800 deg. C.), the mixing with the reducing agent being very intimate.

When the primary reactions have produced both metal and slag, the whole taps itself into No 1 auxiliary inclined hearth, which is heated by any method to 1700 deg. C. Here the oxides of silicon and manganese are reduced and the Si and Mn pass into the bath. This reaction is governed by the carbon entrained in the slag and metal. The alumina is not reduced, as the temperature is not sufficiently high.

2nd Phase.

The high silicon and manganese iron then reaches the second hearth, where it is treated with a highly aluminous and poorly silicated slag. Under high temperature conditions the alumina is reduced in turn, the carbon of the pig-iron, aiding the reaction with the production of ferro-silicon - manganese - aluminium. The slag is expelled and the ferro-alloy is allowed to enter the third hearth. It should be noted that the metal now contains no carbon.

3rd Phase.

This phase carries out the refining, during which the aluminium silicon and manganese are oxidised by means of iron ore, lime, low melting point fluxes.

This combustion considerably increases the temperature and allows of very fluid homogeneous iron to be tapped, due to exothermic reactions. This is one of the economical aspects of the process and is *quite novel.*

If phosphoric ores are treated, the final phase is carried out under strongly oxidising conditions, so as to form rapidly, an ultra basic slag, so as to assure quick dephosphorisation. Desulphurisation is similarly accomplished, so much so, that it is possible to state that the process is capable of reducing any type of ore, even pyrites.

The Process Criticised.

Whilst Mr. Levoz's process may have some technical interest, we cannot possibly envisage it ever becoming really commercial.

Present conditions are such that liquid pig-iron is transferred to a mixer and the mixer metal is later transferred to the open-hearth plant. The quantities are so large that heat losses are relatively small, and additionally, the process is easily controlled because of the slag removals. Any direct process involves the production of large quantities of slag, which, unless adequately provided for, will hinder later reactions.

Mr. Levoz, in the third phase, speaks of the reaction between iron ore and the silicon manganese and aluminium of the bath as being productive of heat units. This we cannot support, as the actual reduction of iron from iron ore requires heat units.

We cannot imagine why metallurgists will waste their time finding out how to make small quantities of iron or steel by a single process, when what amounts to a triplex process is so definitely economical and provides large and continuous amounts.

W. T. GLOVER & COMPANY, LIMITED, of Trafford Park, Manchester, inform us that they have recently opened branch offices and stores at 14, Long Millgate, Manchester.

More About Pearlitic Cast Iron.

As a result of the articles and correspondence which we have published relative to the metallurgical position of pearlitic cast iron, we have received from the British agents for the patentee (Herr August Diefenthaler), Messrs. The Locomobile Engineering Company, Limited, of 57, Victoria Street, S.W.1, some additional information. We have further had an opportunity of perusing the British Patent Specification No. 147,933. In brief, this covers the following points:—

The Pearlitic Patent Specification.

In the use of cast iron for machine parts which are subjected to much friction, such as bearings, steam cylinders, slide blocks, pistons, guides and the like, for a long time, conflicting and very often unsatisfactory results have been experienced. Whilst in some cases such articles last well in use for many years, other machine parts of the same kind soon wear away, and by running hot and corroding, often lead to difficulties in operation. It has been attempted to overcome these drawbacks by producing the cast iron exactly on the basis of analytical experiments, without, however, leading to uniform results.

The patentee has found that it is essential to produce a definite texture or structural condition in such articles in order, in all circumstances, to exclude the difficulties referred to.

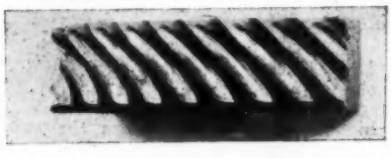


Fig. 1.

Fig. 2.

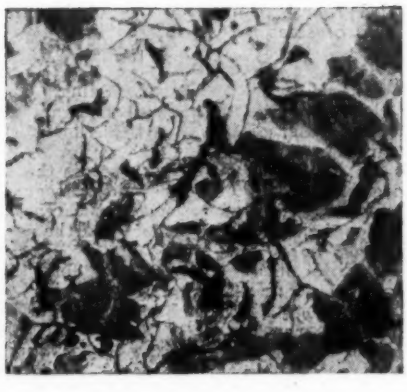


Fig. 3.

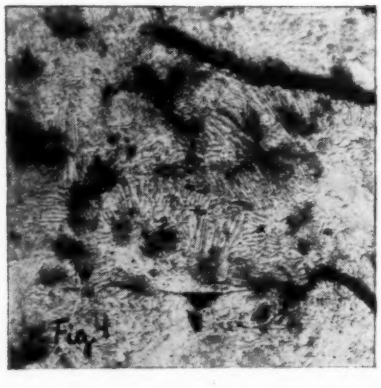


Fig. 4.

The freezing diagram of cast iron shows, as is well known, two distinct conditions: on the one hand, iron with combined carbon, and on the other hand, iron with the carbon in the form of graphite. Between these two limiting conditions—cementite on the one side and ferrite on the other side—the transitional condition of pearlite is formed. The patentee has found that a well-developed, uniformly distributed, lamellar pearlitic structure, with moderate graphite veining, no free ferrite being formed, gives the casting, besides great toughness, the capacity of withstanding frictional wear to a very great degree.

The invention consists, therefore, in producing the casting according to the rules of the iron-carbon crystallisation doctrine, and conducting its cooling in such a way that in the finished piece of work the lamellar pearlite form predominates. This object is obtained advantageously by a cast-iron composition, with a low content of carbon, silicon, manganese, phosphorus and sulphur. The essentials of the process are, firstly, a suitable cast-iron composition, and secondly, cooling gradually in the mould so as to obtain the desired structure in the casting. The thickness of the casting, and other factors on which the cooling rate depends, must be taken into account, and, in order to obtain with certainty the lamellar pearlite structure, excluding free ferrite, desired, the cooling should be effected as gradually as possible. The solution of the problem, therefore, consists in first finding out empirically, for a definite composition and the different cross-sections of the casting, the heat curve according to which with certainty the desired pearlite structure is obtained, and then cooling the finished casting in the mould according to this temperature curve. The invention can be carried into effect satisfactorily by bringing the mould preliminarily to a definite temperature. It has been found, for example, in the case of a composition of 3.0 per cent. carbon (of which 0.85 per cent. is combined with the iron and the remaining 2.15 per cent. occurs as finely-distributed graphite), 1 per cent. silicon, 0.7 per cent. manganese, 0.4 per cent. phosphorus, 0.1 per cent. sulphur, and 94.8 per cent iron, that the mould should be preliminarily heated to the following temperature:—

For a thickness of section of about 2/5 in., to about 200 deg. C.; for about 4/5 in., to about 150 deg. C.; and for about 1 1/5 in., to about 100 deg C.

If the composition is different—for example, if it contains only about 2.8 per cent. carbon (of which 0.85 per cent. is combined with the iron and 1.95 per cent. occurs as finely-distributed graphite) and 0.8 per cent. silicon, the preliminary temperature of the mould should be selected about 40 deg. to 45 deg. C. higher, that is to say:—

For a section of 2/5 in., about 240 deg. C.; for a section of 4/5 in., about 195 deg. C.; and for a section 1 1/5 in., about 145 deg. C.

It may be seen from these examples that it is a comparatively simple matter to prepare scales or curves for a particular composition, from which, without further trouble, the necessary temperature of the mould can be read for a particular thickness of material.

Alternative methods of carrying out the process to produce the lamellar pearlite structure consist in heating the molten iron to a higher temperature such that the excess of heat serves for the necessary heating of the mould or by inserting the mould after casting in a heated chamber, the temperature of which can be easily regulated so as to cool the casting according to the empirically obtained cooling conditions

For preheating the mould a heated chamber may be employed through which the mould is drawn by means of a transporter band or similar means, the duration of travel and temperature of chamber being such that the mould acquires the requisite temperature. The same chamber can be used for the latter of the two alternative methods mentioned. Accordingly the metal is cast in a cold mould, and the mould is brought into the heated chamber as quickly as possible, and left therein for a sufficient time to permit the pearlite structure to develop. In this case also empirical curves can be readily plotted from which, according to the composition, the thickness of the casting and the temperature prevailing in the chamber, the

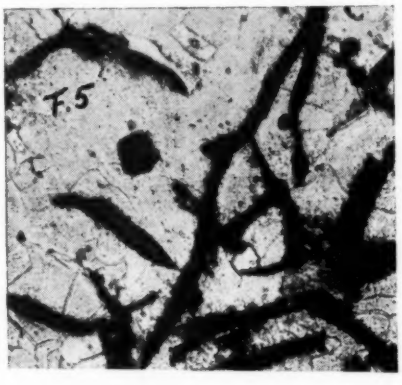


FIG. 5.

requisite duration of the passage of the mould through the chamber can be read off. When the mould is taken out of the chamber, it is allowed to cool in the ordinary way.

According to these technical rules it is possible to produce grey cast iron which will stand frictional wear to a very high degree.

What the Patent Claims.

A method of producing grey cast iron with high resistivity against friction, characterised by the

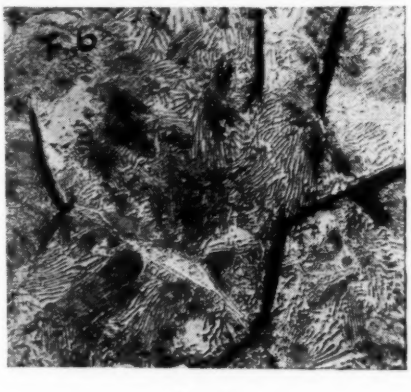


FIG. 6.

feature that by suitable composition and cooling in the mould in accordance with the composition, the structural condition of the finished casting consists of lamellar pearlite preferably with the exclusion of free ferrite

Necessity for Definiteness.

We are indebted to The Locomobile Engineering Company for the explanatory matter which follows:—

It has been observed from a set of piston rings made from the same casting that all showed different degrees of wear after being in use in the same cylinder.

After many years of testing and microscopical examination of the material, it has been found that those rings, or those sections of the rings, the structure of which was characterised by pure pearlite with fine distributed graphite, and without any free ferrite, showed the least wear.

Systematic records were then made of specially-mixed iron containing definite compositions, which were cooled under special conditions, and these led to a definite method of producing the pearlitic structure throughout the whole casting.

It is now a simple matter to cast machine parts of any form and thickness having the true pearlitic structure. These tests show that the pearlitic iron is superior in every way to the ordinary cast iron—even best cylinder iron. It is only very slightly dearer to produce than common cast iron, as the method of obtaining only differs from the ordinary

FIG. 7.

way in that it requires a special mixture, and requires preheated moulds.

The patentee claims that for the many purposes for which common cast iron cannot be adapted, and when malleable iron or cast steel must be used, the much cheaper pearlitic cast iron will fulfil all the necessary conditions.

The most remarkable qualities of the pearlitic cast iron are:—(1) Its great resistance to frictional wear; (2) its great tensile, compression and transverse strength, and its elongation* and toughness or tenacity; (3) its resistance to shock; (4) the durability of its structure at high working

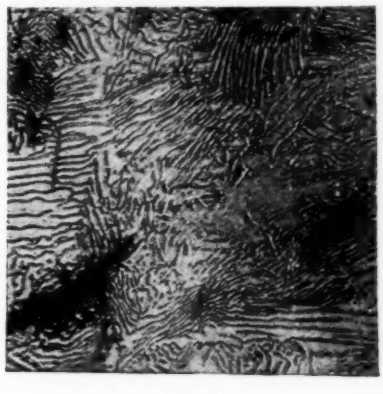


FIG. 8.

temperatures; and (5) its fine and compact grained structure.

The superiority of pearlitic cast iron is demonstrated by the following experiments:—

Friction Tests.

The frictional wear was ascertained by pressing test pieces of 5 × 10 mm. area against a rotating shaft, very little lubrication being applied. The results obtained showed that:—(1) The temperature of common cast iron rose 60 deg. C. at 500 Kg. pressure, when seizings and scoring were most pronounced; (2) pearlitic cast iron rose to 120 deg. C. at 700 Kg. pressure, but no seizing at all resulted from the test.

By multiplying heating by pressure, one obtains a factor for common cast iron of (60 × 500 =

* This is shown later to be 0.8 per cent.—*Ed.*

30,000), or 3.0. For pearlitic cast iron the factor is (120 × 700 = 84,000), or 8.4. The pressure limit of the pearlitic could not be obtained, as the testing apparatus did not allow for higher pressure being applied.

Worm Wheel.

Fig. 1 shows a cast-iron worm wheel which, during the war, was used to replace a bronze wheel. After 30 hours' working it was badly worn. Fig. 2 shows the same design of wheel cast in pearlitic cast iron. After 400 hours' working under same conditions no wear took place. Figs. 3 and 4 show the structure magnified 200 times.

Gear Wheels.

The Technical Department of the German War Office tested two gear wheels, one of ordinary cast iron, the other one of pearlitic cast iron, both under the same conditions. The first one was completely destroyed after 9 hours, whilst the pearlitic iron lasted 19 hours. Figs. 5 and 6 reveal their respective microstructures. In the official report it was stated that cast iron having only a small silicon content slowly cooled, and, having a fine pearlitic structure, was tested according to the Hanemann-Hanfstengel method, and was found very well adapted for the use of gear wheels, and, even when run without lubrication, worked remarkably well.

Piston Rings.

Figs. 7 and 8 show the structure of two piston rings magnified 200 diameter and tested under same conditions. The ordinary cast-iron ring (Fig. 7), after working for 6 weeks, broke down and had to be removed, but the pearlitic ring (Fig. 8), after 1½ years' working, showed no wear at all.

Valves.

The valves and valve-seats of a high-pressure steam engine made of the highest grade of cast iron normally wore away in approximately two months. When made of pearlitic cast iron there was no wear at all after one year's working.

Bearings.

Experiments with bearings made of pearlitic cast iron gave the same advantageous results. The German War Office reported: "We consider pearlitic cast iron the best iron possible for bearing purposes."

Mechanical Strength.

Test bars of 30 mm. diameter by 600 mm. long showed a deflection of 18 mm. and had a transverse strength of 53 Kg. The tensile strength from 27 to 30 Kg. per sq. mm. (17 to 19 tons per sq. in.) associated with an elongation of 0.8 per cent. The Brinell hardness of the pearlitic cast iron is lower than that of other cast irons, because it contains no cementite. From this the patentee insists that pearlitic cast iron is very tough, and somewhat similar to malleable castings.

Driving-Chain Wheels.

In a caterpillar tractor, the driving-chain wheels were made of ordinary cast iron on one side and of pearlitic cast iron on the other side. The cast iron wheel was worn away after two weeks' working on loose sandy ground, whereas the pearlitic cast iron had only just started to polish. The cast-iron wheel was replaced by a cast-steel wheel, whilst the pearlitic wheel remained. After another two weeks' running, the steel wheel showed more wear than the pearlitic cast-iron one. The teeth and the other parts of the pearlitic wheel were equal, so far as toughness was concerned, to the steel wheel.

Dynamic Tests.

Shock tests showed the pearlitic to be eight times stronger than best cylinder cast iron. A piece of normal cast iron was broken with a shock of 4,102 ft.-lbs.; the same section of pearlitic could not be broken even with 32,532 ft.-lbs. Repeated impact tests revealed that ordinary cast iron could withstand 6 blows, best cylinder iron 12, and pearlitic cast iron 32. For this reason pearlitic is well adapted for the manufacture of pistons subject to great stresses or high speed.

Pearlitic will not change its structure even at high working temperatures, as is shown by many examinations of steam- and oil-engine cylinders. From the above it seems logical that for cylinder castings, heated calender rolls and other castings subject to high temperatures, working machine parts, etc., pearlitic cast iron should prove satisfactory. The fine lamellar structure of pearlitic cast iron with thin foliated and equally distributed graphite, and without any cementite and ferrite, gives the iron the best mechanical and tooling qualities.

The author of these remarks believes that Prof. Turner, of Birmingham University, in a Paper read before the British Foundrymen's Association, confirmed many of the conclusions cited above which have reference to pearlitic cast iron.

Summing up, it may be said that pearlitic iron, though produced in pretty well the same manner as common cast iron, can be used with much better results than the latter. Machinery parts made from pearlitic cast iron can be constructed much more easily than when using best ordinary cast iron. Many engine parts, for which up to now the use of malleable iron or cast steel was necessary, can be now made of pearlitic cast iron, and at a lower price. It can be used for cylinders, pistons, piston rings, valves, guides, cross-heads, all sorts of gear wheels, machine tools, beds and toothed wheels of lathes, drilling machines, bearings, etc.

As stated, the commercial side of the patent rights is being handled by the Locomobile Engineering Company

A.F.A. Committee on Specifications for Grey Iron.

E. J. Lowry, secretary of this committee, presented a report dealing with the need for specifications for an international test-bar and for the purchase of pig-iron. The committee, after canvassing the situation thoroughly, had agreed that there was a need for an international test-bar, as the present A.S.T.M. bar is not acceptable under present conditions. A motion by R. S. MacPherran that any specifications adopted should include a statement that the test-bar represents the quality of the iron and not the casting itself was adopted, as well as also a recommendation by Mr. MacPherran that research be conducted to compare the present test-bars with the Fremont-Portervin test of the French development.

Contracts Open.

Burnley, September 5-22.—(1) Constructing reservoir, pump and engine-house, gas and storehouses, girder bridge, etc.; (2) laying of about 1,660 yards of 5-in. and 6-in. cast-iron pipe mains; (3) supply and delivery of 16 tons of 5-in. and 6-in. spigot and socket cast-iron water pipes for the Briercliffe Water Supply, for the Burnley Rural District Council. Mr. H. Pritchard, engineer to the Council.

South Africa, October 15.—Charcoal iron, brass and steel boiler tubes and steel superheater flue tubes (Tender No. 464), for the South African Railways and Harbours. The South African High Commissioner, Trafalgar Square, London, W.C.2.

Toronto, October 9.—247 16-in. cast-iron pipes, for the Department of Works of the City of Toronto. The Department of Overseas Trade (Room 48).

Toronto, October 9.—Stop and check valves, for the Department of Works of the City of Toronto. The Department of Overseas Trade (Room 48).

CONSEQUENT upon the recent purchase by Cammell, Laird & Company, Limited, of the undertaking of the Leeds Forge Company, Limited, and its associated companies, the Bristol Wagon & Carriage Works Company, Limited, and the Newlay Wheel Company, Limited, Leeds, these works, along with the Nottingham works of Cammell, Laird & Company, Limited, and the Midland Railway Carriage & Wagon Company, Limited, Birmingham, will be co-ordinated under the direction of Mr. Arthur S. Bailey, of Nottingham, who has recently been elected managing director of the railway rolling stock department of Cammell, Laird & Company, Limited.

(*Continued from page* 175.)

conditions were finally righted, as they must be in time, then, no doubt, the larger capacity of British foundries would be fully utilised. He had been informed that during the war British foundries were re-equipped with more modern machinery than before; that the old prejudice of the workers against production machinery had largely ceased, and that the old standards of labour and conditions of social life had changed. There had also been a greater interchange of information between countries and the benefits following this resulted from such visits as that which the American delegates were now paying to this country. He was pleased to see that such visits were becoming quite common. America had had during the past few years more visits from delegations from other countries than ever before in its history. Great Britain, of course, had tremendous reserves in coal and iron. He was informed, too, that there were now 3,000 grey-iron foundries in Great Britain having a capacity of 2 million tons, and 100 steel foundries having a capacity of 160,000 tons a year, together with about an equal number of malleable foundries having a capacity of 50,000 tons a year. There were in Great Britain about two-thirds as many grey-iron foundries as there were in America, and yet the area of Great Britain was only about that of one of the smaller Western States. In America there were approximately 3,500 brass foundries. In conclusion, he expressed the sincere thanks of the delegates for the hospitality which was being shown to them, and closed by proposing the toast of their hosts, the Iron and Steel Institute, and the London Branch of the Institute of British Foundrymen, coupling with it the names of Sir Robert Hadfield, representing the Iron and Steel Institute, Mr. Stubbs, the President of the Institution. Mr. Wesley Lambert, the President of the London Branch, and Mr. V. C. Faulkner, the President-elect of the London Branch of the Institute of British Foundrymen.

THE CHAIRMAN, after expressing the thanks of the Institute of British Foundrymen and the Iron and Steel Institute for the toast just proposed, called upon Mr. Oliver Stubbs, President of the Institute of British Foundrymen to speak.

MR. STUBBS said he wished, first of all, to say how very much the Institute of British Foundrymen appreciated the visit which the American delegates were paying to this country. Those members of the Institute of British Foundrymen who had visited America had had such a good time that it was felt that something ought to be done now towards repaying, in part at any rate, the hospitality which had been extended to them. If, therefore, the American visitors found anything of interest in our foundries, and generally, whilst they were here, we should feel very much repaid. He personally was of opinion that the unrest in the world would be very much more quickly settled if it were left to those people in charge of industrial affairs rather than those people who were paid £400 a year to sit in the House of Commons. He would be forgiven for saying that we in this country paid a very big price in connection with the war and were now looking forward to the day when we should return to something like pre-war conditions. We were not grumbling; we did our best; we defended the weaker nations, and we paid a great many lives, as also did America. What were we going to do to bring about a pre-war condition of things so that we should have, in this country, something like the employment we had before the war? The Americans would appreciate what he meant when he said that we had, unfortunately, at the present moment, men who had fought in the war who were still walking about unable to get employment. He knew, also, that they would appreciate his sincerity when he said that he believed the industrial situation of the world would have to be restored by those who were engaged in industry, rather than those who were engaged in what he called professional politics. It was his privilege and honour to meet, during his visit to the States, many of the distinguished members of the American Foundrymen's Association, and he wished to join with the Chairman and Sir Robert Hadfield in saying that we in this country paid a tribute of sympathy to the American nation in the loss that it had sustained in the death of its late President. It had been his privilege to call at White House and be received by Mr President Harding, and in the short space of time he was there he felt he was in the presence of one who realised that right and truth would always carry first. (Applause.) When the delegates went to France he knew they would receive an equally warm welcome to that which they would receive in this country, and as a result of this visit he hoped there would be, once for all, an international friendship between the English-speaking races which had long been overdue, very much overdue. He thanked Mr. Clamer for the way he had spoken of the Institute of British Foundrymen, and—if he might be allowed to digress for a moment—he might add that a programme was being prepared for the visit up North with the determination to make the delegates happy. British foundrymen had been treated so well in the States that they felt they must make an effort to return the compliment when they had American foundrymen in this country.

THE CHAIRMAN mentioned that he had received a telegram from Mr. Slater, the immediate past President of the London Branch, expressing his regret at being unable to be present, and wishing the delegates a most enjoyable evening. He, personally, regretted that Mrs. Lambert could not be present, the reason being that their only son had just, a few hours previously, returned from the Argentine after an absence of eight months, and they could well understand that Mrs. Lambert did not care to leave her son on this occasion.

"The Ladies" Toast.

The toast of the ladies was proposed by Colonel W. F. Cheesewright, D.S.O., in a humorous speech and responded to by Miss J. M. V. Aynesley (member of the Institute of British Foundrymen), who spoke of the great assistance which women could be to men even in such industries as the foundry industry, by their aptitude for attention to detail. She looked to the combination of this ability on the part of women, coupled with the great commercial ability of the men, to aid in the progress of industry.

MR. V. E. MINICH, a member of the Board of Directors of the American Foundrymen's Association, proposed "The Chairman," and referred to his recent visit to America in connection with research upon steamship propellers. Mr. Lambert's firm, he said, was probably the greatest founders of propellers in the world.

THE CHAIRMAN, replying to the toast, said that Mr. Faulkner, the President-elect of the London Branch, ought really to be in the chair, but owing to the fact that the session did not start until October, he was still nominally President. After repeating that it was the desire of foundrymen here to repay in some small measure the great hospitality which was always shown to British foundrymen in America, he commented on the remark made by Mr. Clamer as to the passing away of the old ideas of secrecy in business. When he had approached his own directors for permission for the visitors to see their foundries, there was instant agreement. As a matter of fact, he believed the only people who had been allowed over the foundries before were the London Branch of the Institute of British Foundrymen, and the Greenwich Naval Officers. The works had been in existence for many years as a private company, which was one of the old conservative firms, but even these firms were now opening their doors and allowing visitors to come in. He himself was one of those who recognised that there was a great deal to be learned by that, and he was only too pleased to think that the American visitors had had an opportunity of going over the foundries at his firm's works. Admiral Goodwin had remarked upon the backwardness of British foundries years ago. That was quite true. He himself had been associated with foundry work for 30 or more years, but there had never been anything wrong with the British craftsman. Even 30 years ago the foundry craftsman was the very best, but the foundry trade had always been looked upon as the Cinderella of the engineering industry, and it was largely for that reason that the proprietors of large establishments had not conceded to the foundry the full measure of praise that they should have received, because there was no doubt that the craftsman had always been the very best. Now, he was glad to say, the conditions had changed. Foundries were improving, and he was sure that those who went to Charlton would not say that they were ill-lighted foundries or hole-and-corner foundries. Every provision was made for the workmen in the way of proper washing accommodation, canteens, etc., and everything was done to make things as comfortable as possible, and to recognise the foundryman as a craftsman. The Institute had lately secured a Royal Charter, which was a very great honour indeed, and there was not the slightest doubt that that Royal Charter would so improve the status of the Institute that it would result in the foundryman coming into his own. He believed the day was dawning when the foundryman would be recognised as amongst the highest craftsmen in the engineering world. He thanked them most sincerely for the manner in which the toast had been proposed and received.

There was an excellent musical entertainment during the evening.

VISITORS to the Shipping Exhibition, Olympia, which opens on August 31, will find an instructive and interesting series of demonstrations on Stand No. 17, Row H. This will be occupied by Wailes Dove Bitumastic, Ltd., of Newcastle-on-Tyne, manufacturers of "Bitumastic" preparations.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—With business only partially resumed after the race holiday in the Cleveland iron market during the current week, transactions generally have been on an unimportant scale, while deliveries having been temporarily suspended, stocks in maker's yards have accumulated to a considerable extent. Nevertheless, the aggregate stock of iron on hand does not amount to a very formidable total, and should be speedily reduced when the usual buying to meet autumn requirements is shortly resumed. In the conditions thus outlined, makers are indisposed to make further concessions in prices, and are, indeed, discussing the probability of an advance in quotations in the near future, arguing, with some justice, that current market rates are unremunerative to producers. The only alternative to this course it appears would be to close down plants until a substantial improvement in demand materialises, a step ironmasters are naturally reluctant to contemplate. The very limited extent of business passing this week gave little opportunity for gauging the actual strength of prices, but a few orders were taken for No. 3 Cleveland G.M.B. at 100s., and later at sixpence less, while a corresponding cut was made in the price of No. 4 foundry and No. 4 forge, which became 95s. and 92s. 6d. per ton respectively, but so scarce was No. 1 foundry iron that it was quoted at 105s. per ton.

There has been a marked improvement in the foreign shipments from Tees-side. A steady flow of iron to Hamburg is being maintained, and, as despatches to Scotland are also on a better scale, the August figures are improving. The total quantity of pig-iron shipped from the Tees this month up to and including the 21st inst. was 13,514 tons, compared with 21,325 tons to July 21. With only 13 hematite furnaces now operating on the North-East Coast, compared with 20 only six weeks ago, makers have been hopeful of better prices. But there is a general anxiety to liquidate stocks, and competition for orders is still so keen that, in spite of a rather better demand from Italy, and a little more inquiry from other sources, mixed numbers of East Coast hematite are still obtainable at 98s. 6d., and No. 1 at 99s., per ton. There are some makers, however, who refuse to sell below 110s., and that may soon be the ruling figure, as fuel costs are still high. In the West Coast area it is significant to note the downward movement in prices has been arrested. Bessemer mixed numbers are quoted at £5 10s. per ton delivered at Glasgow and Sheffield, and £5 13s. at Birmingham and South Wales. There is temporarily a slight increase in the make of low phosphorus iron.

MANCHESTER.—Some reduction in the number of Midland blast furnaces in operation is reported, but so far without effect upon current pig-iron quotations, which remain practically unchanged on the basis of last week's prices. Local foundrymen are still adhering to the policy of hand-to-mouth buying, and consequently can have very little iron in stock at present, relying with confident hope on the prospect of lower prices in the immediate future, though it is difficult to find justification for the anticipation. If, however, foundry iron should fall to a point where the consumer would be tempted to hold stock again, there should be an improvement in actual business, and this might occur at a time when many of the furnaces were out of action. Some actual increase in the demand for castings would, however, be necessary before the iron-founders as a whole could regain confidence and build up their reserve stocks of foundry pig.

THE MIDLANDS.—Very little improvement is perceptible in the conditions of the South Staffordshire pig-iron industry, and as far as foundry qualities are concerned the outlook is by no means encouraging. At the moment prices for both Northamptonshire and Derbyshire pig are by no means firm, and it is reported that makers are readily inclined to grant concessions where substantial business can be secured. Smelters complain that without exception they are losing money on every ton of iron they produce, and more of them threaten to go out of action unless there is an early change for the better. Quotations:—Northamptonshire No. 3 foundry, 95s.; Derbyshire No. 3 foundry, 95s., all f.o.t. makers' works.

SCOTLAND.—Conditions in the Scottish pig-iron industry continue quiet and uneventful pending some long-delayed improvement in demand while quotations show an easier tendency. No. 3 quality is now quoted at 102s. 6d. per ton f.o.t. furnaces, but for round parcels 100s. would be accepted. The engineering founders are all very quiet, and there is no hope of any improvement whilst the shipbuilding dispute remains in suspense; meantime there is no sign of a settlement. The heavy-pipe makers are fairly busy, but there is not so much doing amongst the light-castings founders. They can buy No. 3 Middlesbrough at 105s. f.o.t. Grahamston, and No. 4 foundry at 5s. per ton less. There has, however, been very little buying done of late, and for any orders which do come into the market there is keen competition; in fact, to be successful sellers have to accept a shade under the day's actual price.

Finished Iron.

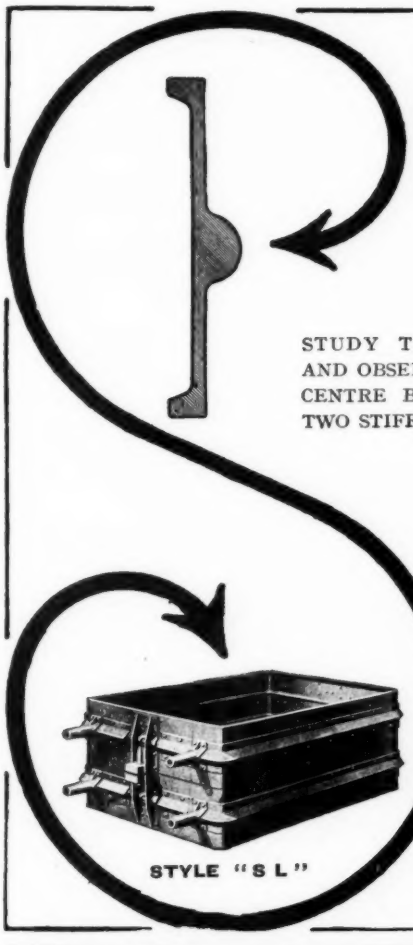
Although comparatively inactive in some departments producing finished material, there is still a certain amount of business passing, although employment generally throughout the industry cannot be regarded as entirely satisfactory, many of the mills and forges continuing short of specifications and working short time. Perhaps the most remarkable feature in connection with finished iron is the way the marked bar basis is maintained at £14 10s. Of course the main reason for this is cost of production rather than demand, although the market for this material continues more steady and better than that for other grades. Nut and bolt iron is subject to very keen and successful Belgian competition at £9, and it is reported that there is a considerable quantity of this iron coming into the Midlands. Better qualities also vary. The one or two firms who have quoted £12 10s. for crown qualities continue to do so, and though they only secure irregular employment it is quite an open question as to whether they are any worse off in this respect than are others who are not so firm. Of course, facts such as these bespeak an excellent reputation for quality, or it could not be done.

Steel.

The outlook in the steel market at the moment, can hardly be regarded as favourable to an early expansion of business, new orders and inquiries having slowed down of late to a large extent, and outputs almost completely confined to the execution of contracts of old standing. At Sheffield makers of all classes of billets are seeking business. The boom in basic steel has quite subsided, while the volume of crucible steel orders, which was showing expansion after a long period of depression, is dwindling again. In the alloys section sellers are endeavouring to make it their own market again, and the damping down of furnaces on ferro-manganese is a sign of the times. For the present, prices are unaltered, and a certain amount of business in limited quantities is noted. American advices show similar restricted buying, with prices shaded a little to $115 in some cases. The market for tinplates is quietly steady. A moderate inquiry during the past week has only, so far, resulted in a small proportion of actual business, and that only for early shipment, buyers all holding off forward purchases in the hope that lower prices will prevail after end of September. Makers' quotations for the standard sizes are as follows:—Coke quality: IC 14 x 20, 112 sheets, 108 lbs., 23s. 1½d. per box; IC 28 x 20, 56 sheets, 108 lbs., 23s. 7½d. per box, with usual options, net cash, f.o.b. Bristol Channel ports.

Scrap.

With prices of all classes of scrap metal now practically reduced to bottom levels, there is, unfortunately, few signs of an approaching improvement in demand, and business in most markets remains dull and unprofitable to merchants. Inquiries for foundry scrap, however, though limited in volume, evidence a slightly increased interest in this material among Lancashire iron-founders, and for the best qualities of cast material, viz., that from broken textile machinery, from 85s. to 87s. 6d. per ton is quoted by dealers, and for good ordinary broken machinery iron 80s. to 82s. 6d. per ton. Apparently the Sheffield steel works will still pay 70s. per ton delivered, but they do not want very much. In South Wales the buying price is about 77s. 6d. to 80s. per ton for heavy steel melting scrap. In the present state of the steel manufacturing trade there is evidently too much scrap about; otherwise it should be worth a good deal more. There is little or no change to report in the scrap trade in Scotland. Prices show a somewhat weaker tendency, but there is little actual reduction so far. Steel scrap still runs about 77s. 6d. to 80s. per ton delivered works, and basic scrap 72s. 6d. to 75s. Cast-iron borings are about 65s. Heavy machinery cast-iron scrap runs about 90s. per ton, and the same price holds good for scrap railway chairs. Light metal and furnace fire-bars are at 65s. per ton.



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IRON, STEEL AND METAL MARKETS—*continued.*

Metals.

Copper.—Conditions in the market for standard copper, on the whole, remain fairly steady, the fluctuations recorded daily, as a rule, being confined within almost fractional limits. An interesting feature on the consuming side was the orders recently placed by the leading British cablemakers for about 700 tons of American wire bars, on terms well in line with official quotations, or on the basis of £70 6s. 3d. to £70 7s. 6d., c.i.f., for August-September arrival, after which further concessions were made. The weakness of standard copper has been largely due to the lack of support, under political apprehensions and the further cutting of prices in America down to 14 cents per lb., and advices that there had been a small increase in the unsold stocks last month owing to decreased deliveries. The outlet for manufactured copper is dull at the further concessions made lately. Current quotations :—*Cash* : Thursday, £64 12s. 6d. ; Friday, £64 2s. 6d. ; Monday, £64 ; Tuesday, £63 12s. 6d. ; Wednesday, £63. *Three Months* : Thursday, £65 5s. ; Friday, £64 17s. 6d. ; Monday, £64 15s. ; Tuesday, £64 7s. 6d. ; Wednesday, £63 15s.

Tin.—Heavy buying for Continental account will explain the steady advance in tin values during the past week, which has resulted in a substantial appreciation, bringing current quotations well over the £190 mark for standard cash. The statistical position is more promising than for the previous month, while it is expected that the visible supply will disclose a reduction. This, of course, depends to a large extent on the deliveries, which should be moderately good, provided the tin which was held up under the recent dock labour troubles becomes released. As to the month's supplies, these will probably be on the light side, due not only to the very small shipments from Java, as cabled recently, but also to indications of very moderate contributions from the Straits. The quantities shipped from the latter source for the first half of August were about 1,900 tons, while the total for the whole month will hardly be much in excess of 4,500 tons. Current quotations :—*Cash* : Thursday, £191 ; Friday, £189 15s. ; Monday, £190 12s. 6d. ; Tuesday, £192 15s. ; Wednesday, £193 5s. *Three Months* : Thursday, £192 ; Friday, £190 17s. 6d. ; Monday, £191 12s. 6d. ; Tuesday, £193 15s. ; Wednesday, £194 7s. 6d.

Spelter.—The market for this metal continues exceptionally active, with consuming demand, if anything, gaining in strength. The shortage of actual metal everywhere is the best point for spelter at the moment. In this country stocks are down to just over a thousand tons, while in the United States there is not more than a fortnight's supply in producers' hands. The United Kingdom imports for all last month only came to 6,363 tons, and statistically the metal is remarkably healthy. Consumers bought a lot of metal recently for forward delivery, and this metal will have to be found. Current quotations :—*Ordinary* : Thursday, £33 12s. 6d. ; Friday, £33 7s. 6d. ; Monday, £32 12s. 6d. ; Tuesday, £33 ; Wednesday, £33.

Lead.—Soft foreign pig continues fairly steady, with values indicating a slightly advancing tendency. Arrivals continue fairly liberal, and as soon as deliveries on an adequate scale are possible, consumers are assured of sufficient material to keep them going for a few weeks at least. The demand in the United States shows a decided improvement, and spot lead is firmly maintained at 6.50 cents per lb. Current quotations :—*Soft foreign (prompt)* : Thursday, £24 10s. ; Friday, £24 10s. ; Monday, £24 10s. ; Tuesday, £24 12s. 6d. ; Wednesday, £24 12s. 6d.

Obituary.

MR. AVON GRAY, King's Heath, died on August 18, in his 65th year. He was interested in two or three local concerns, and retained till his death a seat on the directorate of Barker & Allen, Limited.

MR. W. F. BAGNALL, who has died in the Isle of Man at the age of 49, was the proprietor of the Shalesmoor Foundry, Sheffield, and was one of the original members and a member of the council of the Institute of British Foundrymen.

MR. W. C. WILLIAMS has been appointed representative of Beyer, Peacock & Company, Limited, at their new London offices, Abbey House, Westminster, S.W.1.

MESSRS. H. J. COWLING and W. P. SCOTT, mechanical engineers, Stafford Road, Newport, trading under the style of Cowling and Scott, have dissolved partnership.

Company News.

Metals (1923), Limited, Caledonian Works, Banbury Street, Birmingham.—Capital £2,000 in £1 shares.

The Mint, Birmingham, Limited.—Interim dividend, 6 per cent. per annum, less tax, on preference shares.

Dalmellington Iron Company, Limited.—Final ordinary dividend, 1s. share, making 7½ per cent. for year, free of tax.

Fairbairn, Lawson, Combe, Barbour, Limited.—Interim dividend on preference shares, 5 per cent. per annum ; ordinary, 5 per cent. per annum.

Horton & Son (1923), Limited.—Capital £100. Manufacturers of bolts and nuts, etc. Solicitors : Pinsent & Co., 6, Bennetts Hill, Birmingham.

David Crabtree & Son, Limited, Rope Ironworks, Dick Lane, Laisterdyke, Bradford.—Capital £40,000. Engineers, etc. Directors : D. Crabtree and T. H. Crabtree.

North of England Engineering and Electrical Company, Limited, 125, Albert Road, Middlesbrough.—Capital £1,000. Directors : W. S. Gibson, E. E. Porter and T. Thompson.

J. Stone & Company, Limited.—Net profit, £155,875 ; brought forward, £128,755 ; available, £284,630 ; reserve, £50,000 ; ordinary dividend, 10 per cent. ; carried forward, £147,590.

Newington Butts Engineering Works, Limited, 76, Holyoak Road, London, S.E.—Capital £600. Directors : G. B. Medland (managing director), P. M. Sommerville and R. E. Thompson.

Hunt, Blackman & Company, Limited, 157, Blackfriars Road, London, S.E.—Capital £10,000. Engineers and lift manufacturers and repairers, etc. Directors : J. A. Hume, G. Blackman (chairman) and J. F. Mather.

General Development Company, Limited.—Capital £55,000 in 50,000 12 per cent. cumulative participating preference shares of £1 and 100,000 ordinary of 1s. Ironmasters, etc. Directors : K. E. Bartlett and G. C. H. Wickmann.

Barrotts Castings Company, Limited.—Capital £3,000 in £1 shares, to adopt an agreement with Messrs. Dunham Deacon and Barrett to acquire the business carried on by them at Bedford under the style of Barretts Non-Ferrous Castings Company. Directors : J. Menzies (chairman) and G. H. Barrett.

Walter Scott, Limited.—Brought forward, £2,225 ; credit, £84,399 ; interest for year on 4 per cent. debenture stock, £12,000 ; special reserve, £7,531 ; general reserve, £14,400 ; dividend on 6 per cent. preference shares for two years to June 30, 1923, £36,000 ; ordinary dividend, 2½ per cent., £6,875 ; carry forward, £5,093.

Charles Roberts & Company, Limited.—Report for four years ended June, 1923 : Amount brought forward July 1, 1919, £123 ; profit for four years ended June, 1923, £188,130 ; dividends already paid for three years ended June 30, 1922, £43,068 5s. ; interim dividend for year ended June, 1923, 5 per cent., free of tax, £10,407 ; final dividend for year ended June, 1923, 5 per cent., free of tax, £10,407 ; depreciation of buildings and machinery, £50,000 ; reserve account, £60,000 ; carried forward, £14,370.

Personal.

MR. E. J. CHRISTIAN has joined the board of directors of Sutcliffe Bros. & Bryce, Limited, Globe Works, Hyde, and has been appointed general manager.

MR. F. DOWDING has resigned his position as London sales representative of the Sheffield Twist Drill & Steel Company, Limited, whose London offices are at Mansion House Chambers, 11, Queen Victoria Street, E.C.

MR. JAMES NEILL, chairman of James Neill & Company (Sheffield), Limited, Composite Steel Works, and a director of the Tinsley Rolling Mills Company, Limited, will be elected Master Cutler in succession to Mr. R. W. Matthews. Lord Derby will be the guest of honour at the feast on October 25.

PROFESSOR MATTHEW HAY, who has been the chairman of directors of the Callendar Iron Company, Limited, since the start of the company 47 years ago, has decided to retire. He is being succeeded by his son, Major Matthew Hay. For family reasons and the readjustment of interests, it will be necessary for the company to go into voluntary liquidation, which, however, is a purely formal proceeding.

Wills.

BACK, A. C. L., consulting engineer, of Fairlie, Compton Park, Plymouth	£19,012
BARLAS, D., formerly secretary of the Tharsis Sulphur & Copper Company, Limited ...	£15,693
CORDINGLEY, J. R., of Ellison, Cordingley & Company, engineers and machine makers	£8,892